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23 November 1956

Volume 124, Number 3230

6 NOV 26 1956
Cont. Copy

Editorial

Secondary-School Science and Mathematics 1009

Articles

Current Status of Insect Control by Radiation: *C. C. Hassett* 1011

Traveling High-School Science Libraries: *H. J. Deason* 1013

H. Devaux, Plant Physiologist, Pioneer of Surface Physics: *J. G. Kaplan* 1017

News of Science

U.N. Committee on Effects of Atomic Radiation; Intermedin; Second Atoms-for-Peace Team Visiting Latin America; Reactor for Japan; Microcards for WMO's IGY Work; Another Voice on Radiation Effects; AEC Offices Abroad; Tranquilizing Drugs; News Briefs; Scientists in the News; Recent Deaths; Education; Grants, Fellowships, and Awards; In the Laboratories 1019

Reports

Use of Acridine-Orange Fluorescence Technique in Exfoliative Cytology: *L. von Bertalanffy, F. Masin, M. Masin* 1024

Consistent Running Records: *G. P. Meade; M. H. Lietzke* 1025

Survival of Amino Acids in Marine Sediments: *J. G. Erdman, E. M. Marlett, W. E. Hanson* 1026

On the Presence of Free Sugars in Filtered Lake Water: *J. R. Vallentyne* and *J. R. Whittaker* 1026

Method for Predicting Amount of Strontium-89 in Marine Fishes by External Monitoring: *H. Boroughs, S. J. Townsley, R. W. Hiatt* 1027

Protein Adsorption on Filter Paper: *H. Waldmann-Meyer* and *K. Schilling* 1028

Peralta Complex—A Sonoran Variant of the Cochise Culture: *G. E. Fay* .. 1029

Extraction of $C_{21}O_5$ and $C_{21}O_6$ Steroids from Aqueous Media: *S. Burstein* 1030

Book Reviews

Man in Search of His Ancestors; In Search of Adam; Handbook of South American Geology; Handbuch der Physik; Psychology of Industrial Conflict; Fire Research, 1955; Behavior Theory and Conditioning; The Chemistry of the Coordination Compounds; Agricultural Ecology; New Books; Miscellaneous Publications 1031

Meetings and Societies

AIBS Connecticut Meetings; Atomic Trade Fair; Programs in Mathematics, Physical Science, and Earth Sciences at AAAS New York Meeting; Meeting Notes; Society Elections; Forthcoming Events 1036

Equipment News 1047

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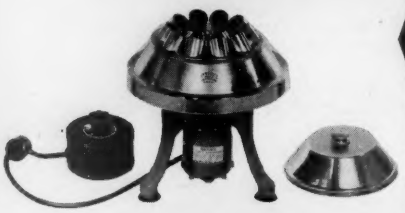

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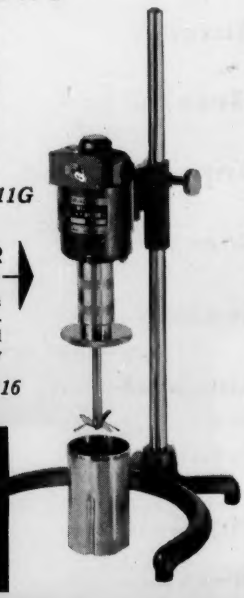

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Secondary-School Science and Mathematics

It is now clear to both scientists and educators that secondary-school science and mathematics courses must be revised, so that the teaching of science and mathematics in secondary schools can reflect more adequately modern scientific developments. If this is to be accomplished, scientists must be deeply involved and, in many instances, will have to take the initiative. It is probable that this work can be done most effectively by working groups of scientists and secondary-school teachers and administrators.

In October the AAAS held a Conference on Mathematics Instruction. Participating in this conference were mathematicians, scientists in the other fields that depend heavily on mathematics, and teachers at the elementary and secondary levels. The purpose of the conference was to review present efforts to improve the teaching of mathematics and to explore whether there were ways in which AAAS could be of help in this effort. The conference revealed that important studies in the secondary-school mathematics curriculum are under way, and that leading mathematicians are active in this work. The most notable studies for the secondary-school level are by the Commission on Mathematics of the College Entrance Examination Board and by the University of Illinois Committee on School Mathematics. The National Council of Teachers of Mathematics is organizing a study of mathematics in grades 1 to 12, and their plans also call for very active participation of mathematicians.

A major study, directed toward a rather complete revision of the physical science courses in secondary schools, is being developed. Other scientific societies have committees which are examining ways of improving these courses. In Kentucky there is a state-wide committee, composed of scientists and secondary-school teachers, which is undertaking an important study of the science curriculum for grades 1 to 12. A similar study is in the planning stage in California for elementary-school science. Both of these projects are operating in cooperation with the state departments of education and include scientists as well as elementary- and secondary-school teachers. In addition to the great values that will come from better science and mathematics courses, curriculum study of this kind will enable scientists and school personnel to develop much more satisfactory and continuing working relationships.

Since the American school system is organized on a state-wide basis, much of the work in curriculum revision will have to be done at the state level. It is recommended that scientists concerned with this problem investigate possibilities of the establishment of a curriculum committee in their states in cooperation with state departments of education. The national studies will depend on the states both for experimentation with proposed new materials and for implementation of recommendations. Such state committees will be in an excellent position to assist in the national studies and to see that the recommendations of the national groups are understood and accepted, and without too much delay. This is the time for action at both the national and state levels.—JOHN R. MAYOR, *AAAS Science Teaching Improvement Program.*

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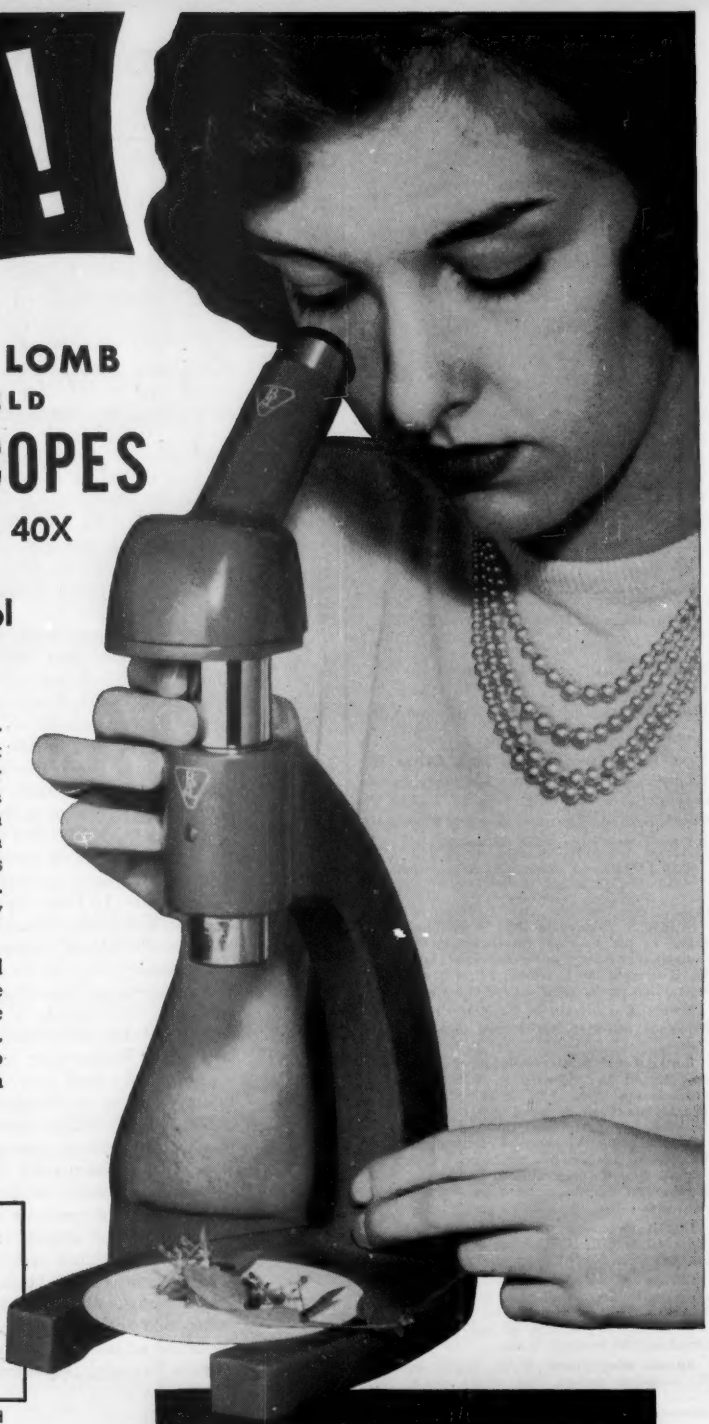

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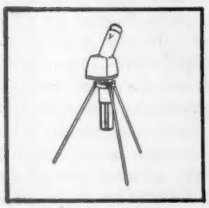

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Current Status of Insect Control by Radiation

Charles C. Hassett

The losses occasioned by insect pests in stored products amount to well over a billion dollars a year in the United States alone. Losses occur in stored grains before processing, in packaged food products, in clothing and other textiles, and in lumber and wooden articles. Control of the insects responsible for these losses is a large-scale problem, and tremendous savings could be achieved by the development of methods more effective than those currently in use.

The best methods of insect control today depend on the use of various chemical agents, most of which have been developed in recent years. These insecticides have been sensationally successful in use against the pests that affect standing crops and stored unprocessed grains. Toxic chemicals cannot, however, be applied to foods and clothing, or to other finished products that must undergo storage, during which the attacks of insects are costly. This has led to the consideration of various forms of radiant energy for the protection of stored products.

Controls Other Than Chemical

There are several forms of radiation that can be used to kill insects, each having its own characteristics, advantages, and disadvantages. A number of investigators have tested the effects of sound waves above the audible range, especially between 50,000 and 100,000 cycles per second, and have found that they are destructive to living organisms. It is not certain, however, that the apparatus for producing such frequencies is adaptable to large-scale treatment of material containing insects. A more promising form of energy is found in high-frequency radio waves which cause what is known as dielectric heating in nonconducting bodies. Soderholm (*1*) has reported the use of this method on rice weevils and on the pink bollworm. The apparatus used produced electric fields with alternating frequencies of 40 megacycles per second. This raised the temperatures of the material in the field and killed the insects. The heating was not high enough to damage the grain or cottonseed that surrounded the insects. The weevils were killed by 1-second exposure, the bollworms after 14 to 29 seconds in the field.

Frings (*2*) reported success in killing several common insects by the same method in laboratory trials. Baker, Wiant, and Taboada (*3*) have applied radio frequencies of 2450 megacycles per second to grain containing *Tribolium confusum* and *Sitophilus granarius*. This test, like the others, was done on a small scale, but the authors, by combining their data with those of Schaefer and Schwan (*4*) were able to calculate the over-all costs of using dielectric heating at $2.60 per ton of grain processed. All three of these tests were performed with commercial equipment which could be developed into a practical means of treating moderately large quantities of material. The use of radio-frequency heating would seem to be potentially useful for insect control under some conditions, although it is doubtful that it can be used on a very large scale. Neither can it be used on heat-sensitive materials.

Dr. Hassett is a member of the physiology division, Directorate of Medical Research, Army Chemical Center, Maryland.

New Sources of Radiation

Recent developments in physics have produced several new sources of radiation, some of which seem certain to be applicable to insect control. All derive either from some type of particle accelerator or from the radioactive decay of various elements.

Particle accelerators produce beams of subatomic particles traveling at extremely high speeds. The particles may be electrons, protons, or other kinds of atomic fragments. Only electron accelerators are of interest for insect control, because the others are far too costly and elaborate. The Van de Graaff electrostatic generator and other models of electron accelerators are in common use and are not unduly costly. All electron radiation, however, is limited to relatively thin layers of material or to surface irradiation of thick objects. Electrons penetrate only a few millimeters of most substances, which limits their use considerably, but this disadvantage is balanced somewhat by the relatively light shielding required to protect personnel. Another advantage is that, unlike radioactive radiation, the electron beam can be shut off when it is not wanted, which makes for safer and more convenient operation. All such apparatus is, however, subject to failure of tubes or other parts, which may be costly.

Radioactive elements, often referred to as radioisotopes, offer another, and very useful, source of radiation. There are already in use a number of cobalt-60 units of high intensity, rated in thousands of curies. Cobalt-60 emits strong gamma rays, which, like x-rays, penetrate deeply. Much larger objects can be treated with a gamma source than is possible with any type of electron machine. Heavy shielding must be provided to protect personnel from the effects of this radiation.

The operation of nuclear reactors, or piles, results in the accumulation of very large quantities of radioactive elements of various intensities and with differing decay periods. The safe disposal of these wastes is at present a serious problem, and means are being sought to develop practical ways of concentrating, separating, and applying to use those radioisotopes which possess the proper characteristics. Both gamma and beta (electron) radiation can be extracted from

these wastes, or, if desired, the crude waste need only be concentrated and the total radiation used. Still another source of radiation from the uranium reactor has been suggested: this is the use of spent fuel rods from the pile. Any of these sources of radiation, which are now largely useless, could be fabricated into units of suitable size and intensity to furnish radiation for processing large quantities of products of many kinds.

Costs of Control by Radiation

Are the devices described here practical solutions to the problem of killing insects that infest large quantities of food and other packaged products? The answer to this question lies in measuring the amount of radiation that is necessary to kill the insects and in the cost of the equipment and the operating expenses. Baker *et al.* (*3*) calculated that the cost of doing the work by dielectric heating was reasonable. Costs have been estimated for the various other types of radiation treatments. Measurements of the lethal dose by gamma radiation and the dose necessary to prevent reproduction have been made by Hassett and Jenkins (*5*) in experiments at Brookhaven National Laboratory. It was found that a variety of the common pests of stored products, including the carpet beetle, cigarette beetle, rice weevil, powder-post beetle, and others, can be killed rapidly by doses of 65,000 roentgens and rendered incapable of reproducing by 16,000 roentgens. These doses could be delivered by irradiation units using any of the wastes described in the preceding paragraph. Their results were confirmed later by Proctor *et al.* (*6*) on the same insects, with the exception of the powder-post beetle.

Table 1. Estimates of capacity and cost for facilities designed to treat stored products. Some values recalculated for uniformity. Cost estimates include construction and operation.

Reference	Energy source	Capacity	Cost/ton
3	Dielectric heat	1000 lbs/hr	$ 2.60
6	Electron accelerator	2 tons/hr	20.40
8	Cobalt-60	1260 lbs/hr	10.00
9	Spent fuel rods	27 tons/hr	0.75
8	Cesium-137	8 tons/hr	2.53
	Mixed fission products	8 tons/hr	3.23
	Spent fuel rods	8 tons/hr	2.45
	Spent fuel rods	27 tons/hr	0.94

At present there are no cost estimates based on actual operation of equipment for destruction of insects. There are, however, several studies that include cost estimates for this or similar purposes (Table 1). In the Stanford Research Institute report to the U.S. Atomic Energy Commission (*7*), it was estimated that, as soon as an efficient process could be evolved for separating useful istotopes (for example, cesium-137) from bulk fission waste, there would be an economically feasible use for it in sterilizing penicillin.

In 1955, the Brookhaven National Laboratory held a conference to consider the development of methods for prestorage irradiation of potatoes. A dose of 20,000 roentgens has been found to prevent sprouting of stored potatoes, thus extending the safe period of storage considerably. Both electron and gamma-ray irradiation were considered practical. Detailed plans were presented for the irradiation of large quantities of potatoes by both methods. Electron accelerators now on the market need only be adapted to a specific use by adjustment of the beam size and intensity, with provision for material-handling equipment such as conveyors. Proctor *et al.* (*6*), basing their estimate on the use of such an electron accelerator, consider that material can be processed at a reasonable cost (Table 1).

No commercial gamma irradiation units are now operating, but Otto Kuhl, of the Brookhaven National Laboratory, presented plans of a pilot model usable for potatoes or other products (*8*). This consists of a truck and trailer, carrying a cobalt-60 irradiation unit, with accessory conveyor belts and the necessary shielding, to process 15 tons per day (24 hours) at a cost of $10 per ton (5¢ per pound). This includes all costs, amortizing the original cost over 5 years.

The Fission Products Laboratory, University of Michigan (*8, 9*), presented plans for a unit to operate on either cesium-137 or mixed fission products, or even on spent reactor fuel elements. The facility could be fixed or could be built into a railroad boxcar. This unit would process 6400 bushels per day at a cost of 6¢ to 8¢ per bushel, or $2.50 per ton.

All these facilities, whether or not specifically designed for the destruction of insects, could be used to process a wide variety of food products, clothing, or wooden objects. If such material were wrapped in insectproof covers before processing, any existing insects would be killed and no reinfestation could occur. It has been shown by a number of studies that the doses required would have no effect on the taste and vitamin content of foods (*6, 8–10*), and there would be, of course, no residue of any kind, for these radiations do not induce radioactivity. Radiant energy can, therefore, provide a safe, nondestructive, means of ridding many stored products of insect pests.

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Traveling High-School Science Libraries

Hilary J. Deason

The Traveling High School Science Library Program, now in its second year, is supported by a grant from the National Science Foundation and is administered by the AAAS. The program reflects the great interest of both agencies in assuring scientific manpower for the future and recognizes that most careers in science actually begin during high-school education. The majority of the high-school students in the United States live in localities where neither the school library nor the public library, if there are such libraries, afford adequate opportunity for recreational and collateral reading in the sciences and mathematics.

The general purposes of the program are to stimulate an interest in reading science and mathematics books, to broaden the science background of high-school students, and to assist students with scientific interests in choosing careers in the sciences. In addition, although it is not a primary objective, the program acquaints teachers and librarians with books on science and mathematics that are suitable for general reading by high-school students and that would be appropriate acquisitions for the school or community library.

During 1955–56 the traveling library consisted of 150 books that were circulated to 66 high schools in various parts of the United States. The books and schools were reported in *The Scientific Monthly* [**82**, 51 (1956)] and in *Science* [**122**, 1173 (1955)]. Circulation records of the books maintained at each school were analyzed statistically. Questionnaires were completed by the 11th- and 12th-grade students at the program schools which gave their reactions to the program and their appraisal of the books in the library.

In 1956–57 the traveling library consists of 200 books: 112 of the 150 included in the 1955–56 library, and 88 new selections. The selections were based on the suggestions of more than 200 individuals made in the summers of 1955 and 1956, on the 1955–56 circulation records and summaries of student questionnaires, and on the suggestions and appraisals of the original list which were made by representatives of the following organizations.

AAAS, AAAS Cooperative Committee on the Teaching of Science and Mathematics, American Association of Physics Teachers, American Association of School Librarians, American Chemical Society, American Dental Association, American Institute of Biological Sciences, American Library Association, American Medical Association, American Meteorological Society, American Pharmaceutical Association, American Psychological Association, American Society of Agronomy, American Society of Limnology and Oceanography, Association of Geology Teachers, District of Columbia Public Library, Mathematical Association of America, National Association of Biology Teachers, National Research Council, National Science Foundation, National Science Teachers Association, National Society of Professional Engineers, New York Public Library, Society of American Foresters, Society of Systematic Zoology, Special Libraries Association, U.S. Office of Education, and the Wildlife Society.

The number of excellent books recommended far exceeded the maximum of 200 that could be included in the library, and many decisions had to be made by the director of the program and his associates. A few recently published books that had not yet been brought to the attention of the advisory organizations and individuals were included. These will be evaluated by the program during the year. All the selected books have been reviewed by the director, and many were reviewed and appraised during the past summer by two young men, one a college freshman and the other a senior in high school.

Biography and autobiography, history of science and mathematics, and applied science are well represented in the 1956–57 library. An attempt has been made to provide a very broad range of subject matter so that a student may acquaint himself with the major branches of science and discern the practical application of the sciences and mathematics in research, in the professions, and in industry. As a rule, textbooks were not selected except when no trade books were available that covered the same subject matter. For obvious reasons, only books currently in print and available for purchase have been included.

The AAAS will evaluate the effectiveness of the Traveling Science Library Program and assess the interest of high-school students in the individual books in the library. This study will be based on the actual book circulation records at each school and on questionnaires to be completed by students at the program schools and at selected matching control schools that are not receiving the library.

A list of the 200 books in the present traveling library follows. Those that also were in the 1955–56 list of 150 are marked with an asterisk.

Books in the Libraries

Allen, D. L. *Our Wildlife Legacy.* Funk & Wagnalls, 1954.

*Alter, D., and C. H. Cleminshaw. *Pictorial Astronomy.* Crowell, 1952.

*Andrews, R. C. *Beyond Adventure: The Lives of Three Explorers.* Duell, Sloan and Pearce, 1954.

*Andrews, R. C. *This Amazing Planet.* Putnam's, 1940.

Archer, S. G. *Soil Conservation.* Univ. of Oklahoma, 1956.

Asimov, I. *Chemicals of Life.* Abelard-Schuman, 1954.

Asimov, I. *Inside the Atom.* Abelard-Schuman, 1956.

*Baitsell, G. A. (Ed.) *Science in Progress.* Yale Univ. *1st ser., 1939; 2nd ser., 1940; 3rd ser., 1942; *4th ser., 1945; *5th ser., 1947; *6th ser., 1949; *7th ser., 1951; *8th ser., 1953.

*Bakst, A. *Mathematics: Its Magic and Mastery.* Van Nostrand, 1952.

*Ball, M. W. *This Fascinating Oil Business.* Bobbs-Merrill, 1940.

*Bates, M. *The Prevalence of People.* Scribner's, 1955.

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Dr. Deason is director of the AAAS Traveling High School Science Library Program.

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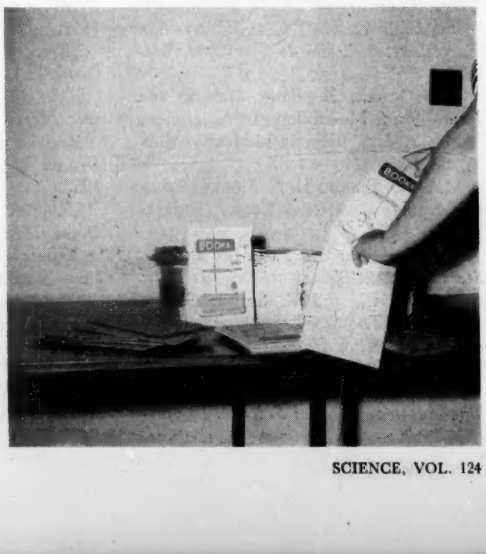
Program Schools

During 1956–57 a total of 104 schools are participating in the Traveling Science Library Program. Twenty-six sets of the library are being circulated to the program schools and two sets are being used for exhibition at scientific meetings and at meetings of teachers and librarians. Each school receives 50 books at a time. The books are used for two months. During the summer of 1957 the traveling libraries will be used at the institutes for science and mathematics teachers sponsored by the National Science Foundation.

The greatest apparent need for the traveling libraries is in small and medium-sized high schools in nonmetropolitan localities. Recommendations were solicited from state departments of education and from well-informed faculty members of universities and colleges. Each recommended school was informed of the program and invited to send information on its enrollment, curriculum, faculty, and library facilities, and to indicate whether it was interested in becoming a part of the program. The 104 participants were selected from a much larger number of responses to afford a wide geographic distribution and to represent a diversity of local socioeconomic conditions. Most of the schools are in nonmetropolitan areas and have an enrollment of between 200 and 600 students in the ninth to 12th grades, inclusive. Both public and private schools are represented. Two large senior high schools in the Washington metropolitan area and an exceptional junior high school have been included for comparison. The 104 program schools are as follows.

Alabama: Baldwin County High School; J. U. Blacksher High School, Uriah; Choctaw County High School; Decatur High School; Montevallo High School; Randolph County High School; Semmes High School; West Blockton High School.

Arkansas: Bentonville High School; Harrison High School; Jacksonville High School; Ozark High School.



The AAAS has published an annotated catalog of the traveling library. It is available to teachers and school librarians on request.

California: Calexico Union High School; Needles Union High School; Pomona Catholic High School; Santa Ynez Valley High School.

Colorado: Central High School, Grand Junction; Delta High School; Sheridan Union High School, Englewood; Holy Trinity High School, Trinidad.

Connecticut: Darien High School; Griswold High School, Jewett City; Housatonic Valley Regional High School, Falls Village; Watertown High School.

District of Columbia: Alice Deal Junior High School; Hebrew Academy of Washington; Woodrow Wilson High School.

Indiana: Chesterton High School; Lebanon Junior-Senior High School; Western High School, Russiaville; Tipton High School.

Iowa: Britt High School; Clarinda High School; Estherville High School; Sumner High School.

Louisiana: DeRidder High School; Haynesville High School; Minden High School; Natchitoches High School.

Maryland: Howard County High School; Northern Garrett County High School; Northwestern Senior High School, Hyattsville; Northwood Junior-Senior High School, Silver Spring; Walter Johnson Senior High School, Rockville; Wheaton Senior High School; Wicomico Senior High School, Salisbury; Wiley H. Bates High School, Annapolis.

Michigan: Holland Christian High School; Marlette Community High School; Newaygo High School; Okemos High School; Rodney Wilson High School, St. Johns; Union High School, Greenville; Warren High School; Washington Gardner High School, Albion.

Minnesota: Cloquet High School; Detroit Lakes High School; Fergus Falls High School; Grand Rapids High School; Lourdes Central Catholic High School, Rochester; Mapleton High School; Northfield High School; Worthington Senior High School.

Montana: Anaconda Public High School; Beaverhead County High School, Dillon; Fergus County High School, Lewiston; Libby High School.

New York: Canandaigua Academy; Glens Falls High School; Herkimer Central High School; Hornell Senior High School; Interlaken Central School; Northside High School, Corning; Oneonta High School; Plattsburgh High School.

North Carolina: Bunker Hill High School, Claremont; Charity High School, Rosehill; Davis County High School; Highland High School, Gastonia; Jones Central High School, Trenton; North Davidson High School, Lexington; Price High School, Salisbury; Shepard High School, Zebulon.

North Dakota: Hettinger High School; Valley City High School; Wahpeton High School; Williston High School.

Oklahoma: Clinton High School; McAlester High School; Norman High School; Shawnee High School.

Texas: Killeen High School; Rio Grande City High School; Seguin High School; Weslaco High School.

Virginia: Bluestone High School, Chase City; Halifax County High School; Martinsville High School; Robert E. Lee High School, Staunton; St. Stephen's School, Alexandria.

West Virginia: Dunbar High School; Sherman High School, Seth; Sophia High School; Sutton High School.

A Basic List of Science Books for High Schools

The AAAS has published a descriptive catalog of the books in the traveling libraries which is available to teachers and high-school librarians on request. This book list, although limited in scope, proved to be in demand last year as a guide for purchasing books for school and community libraries.

The AAAS, with the cooperation of the National Science Foundation, plans to publish late in 1957 a basic list of science and mathematics books for high-school libraries and other libraries used by young people. The number of titles in the proposed book list will not be limited, and the list will include the kinds of books in the traveling library, as well as standard reference books, natural history keys and field guides, and a selected group of basic textbooks. The list will be based on the many suggestions for the traveling library made by individuals and representatives of organizations and will be compiled by a small committee of specialists in the teaching of science and mathematics, library supervisors, and others. Such a list will meet a need frequently mentioned by school officers, teachers, and librarians.

The AAAS solicits the comments and suggestions of students, teachers, librarians, scientists, and others concerning the traveling library program, and will be glad to receive comments concerning books now in the traveling library or books not in the traveling library that are suggested for the basic book list. In suggesting books kindly list the author, title, and publisher to facilitate the identification and examination of your suggestions and recommendations.

H. Devaux, Plant Physiologist, Pioneer of Surface Physics

Henri Edgard Devaux, professor emeritus of plant physiology at the University of Bordeaux, died on 14 March 1956, at the age of 93 years. Although he was physically infirm for many years, this remarkable man was active scientifically until his death. His last publication, "The mystery of the second fertilization of angiosperms. . . ." appeared in the *Comptes rendues* of the Academy of Sciences, session of 4 January 1956; his first paper, "On the variation of growth and development of plants at different hours of the day" appeared in 1882; thus his productive scientific life extended over a period of 74 years.

Henri Devaux was born on 6 July 1862, in the village of Etaules (Charente-Maritime) to a Protestant family of farmers and seafarers. In 1884, he was awarded a scholarship to the University of Bordeaux, where he studied pharmacy and natural science. In 1887, he came to the Sorbonne where he remained for 4 years, receiving his doctorate in 1889, his thesis having to do with the mechanism of gaseous exchange of plants. In 1891, after a short stay at the University of Dijon, he returned to the University of Bordeaux, where in 1906 the first chair of plant physiology in provincial France was created for him, a post which he occupied until his retirement in 1932 at the age of 70. After his retirement, he retained a small laboratory in the Faculty of Sciences at Bordeaux in which he worked actively until

1950, when a fractured femur forced him to transfer his research activities to a small front room in his home, where he continued his experiments aided by his faithful technician, Henriette Lafon, who worked with him for 18 years. (I am indebted to Mlle. Lafon and Mme. E. Devaux-Morin, for many biographical details, and to J. H. Schulman, for helpful advice.)

Although Devaux worked actively in cellular physiology and in plant histology, his major contributions to science were in the field of molecular physics, and it was under this heading that most of his contributions to the *Comptes rendues* appeared. It was in November 1903 that Devaux published his first memoir on the properties of surface films of various substances and gave rigorous proof that they were actually monomolecular in nature. Although credit for the discovery of monomolecular films belongs to Lord Rayleigh, Devaux was the first to demonstrate that a wide variety of substances other than oils could be caused to spread into thin films of molecular dimensions and thus helped lay the foundation upon which were built our present concepts of the structure of matter.

Devaux's experimental work was always extremely clear in theory and amazingly simple in apparatus and technique. His initial measurements of length and cross section of fatty acid molecules were made using nothing more complex than a photographer's developing tray, powdered talc, and some strips of paper with which to compress the surface films. An excellent summary of Devaux's methods may be found in the classical paper of Langmuir, "The constitution and fundamental properties of liquids" [*J. Am. Chem. Soc.* **39**, 1848 (1917)]; Langmuir relied heavily on Devaux's work in providing evidence for his revolutionary doctrine that the structural formulas of the organic chemist were to be taken literally as guides to the reactivity and structure of molecules, and that the chemical properties of organic compounds could be attributed to the presence of certain chemically active portions of the molecule, the "group molecules," or polar groups, rather than to the reactivity of the molecule as a whole.

Devaux was a pioneer in the field of protein surface chemistry, demonstrating in 1903 that even highly water-soluble proteins like albumin would spread at the air/water interface into monolayers, and using surface methods to measure the dimensions of protein molecules. He was also able to make essentially correct conclusions concerning the stereochemistry of oleic acid by comparing its cross section and length at the air/water interface with those of stearic acid. He applied his methods to the study of inorganic substances such as the sulfates of mercury, lead, and copper and was thus led in 1912 to reintroduce the mercury trough, originally used by K. T. Fischer in 1896. He found that on a mercury surface many organic and inorganic substances formed thin films of molecular dimensions (for example, sulfuric acid) which could thus be easily and elegantly studied. He also demonstrated the two-dimensional surface crystallization of salts and other substances at the mercury/water interface and devoted many years to the study of the physical and optical properties and the permeability of such films.

Devaux's work became known abroad rather quickly; translation of one of his memoirs into English was undertaken by the Smithsonian Institution in 1912, and he became well known to his American and English confreres as a result of the extensive and generous citation of his work by Langmuir in several publications. His name has been attached to two phenomena that he discovered in the 1930's (both called the *Devaux effect*), the first being the irreversible transformation of protein films into solid fibers, resulting from compression and collapse of the films (Mazia-Hayashi), and the second being the crinkling of protein-stabilized oil/water interfaces, caused by diminishing experimentally the volume of the dispersed oil droplets (Kopac); both Devaux effects have been useful in studies of cell function and structure. In 1946, the Faraday Society took the initiative in planning a meeting (jointly with the Société de Chimie Physique) which was held in Bordeaux to honor Devaux; he took an active part in all the sessions.

It is sad to have to record that recognition in France was very slow in coming to Devaux and that he never achieved there the prominence which he merited and which, indeed, he achieved beyond the frontiers of his own country. In this, he shared the fate of other outstanding French scientists who, as a result of being attached to the provincial universities of that highly centralized country, are virtually unknown in other regions of France, whereas the occupants of the chairs of the Paris faculties achieve almost automatically a prominence sometimes quite out of proportion to their contributions. Devaux became a correspondent of the Academy of Sciences only in the year following his retirement and was elected to nonresident membership in 1946, on the eve of his 84th birthday.

Those who have seen Devaux in his laboratory will always hold memories of this enthusiastic savant bent over his mercury tray much as a great virtuoso over his keyboard. With contempt for the scientific proprieties of the present era, he would touch the side of his nose with his fingernail to obtain a bit of sebum with which to demonstrate the surface behavior of oils; as a ready source of protein, a drop of saliva would suffice for a demonstration that would entrance the visitor. One could easily visualize his joy when as a young man in 1888 he created his famous camphor boat: a small piece of camphor placed over the notched end of a paper "boat," complete with mast and pennant, would "give for hours on end a rapid and regular movement," a motion that could be opposed or stopped by films of other surface-active agents. Later he joyfully announced that he could "smell monolayers" by compressing films of perfumes beyond their collapse pressure. He created many other ingenious models of molecules at surfaces; let us cite only his "films" of lentils, oats, and other grains, which when floating at the mercury surface permitted visualization of the effect of compression on the packing and orientation of interfacially adsorbed molecules [see his illustrated memoir in the *Journal de Physique et le Radium* **9**, 441 (1938)].

Devaux was a deeply religious man and was unable to conceal that intensity of belief and devotion to his church which in France often characterizes the Protestant and which in the English-speaking countries seems to characterize the Catholic but which in all countries typifies the adherent to unpopular or minority faiths. He explicitly rejected Claude Bernard's famous dictum that there should exist no connection between oratory and laboratory, although he was well aware that in this he was virtually alone among his scientific colleagues. For Devaux, science and religion were one, and his experimental work had for him almost the quality of divine worship. His work was marked by this fervor but also by a gentle sense of humor and by a certain artistic flavor which is, perhaps inevitably, disappearing from the scientific literature of today.

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News of Science

U.N. Committee on Effects of Atomic Radiation

The 15-nation Scientific Committee on the Effects of Atomic Radiation has concluded its second 2-week session at United Nations Headquarters in New York. The committee has reviewed the extensive series of reports reviewed in response to its request on the levels of radiation and radioactivity from natural and artificial sources [*Science* **123**, 928 (25 May 1956)].

Besides considering information submitted to it, the committee invited specialized studies by the Food and Agriculture Organization and other groups; surveyed methods for measuring radiation and endorsed World Health Organization and United Nations Educational, Scientific and Cultural Organization programs for supplying calibration standards and instruments in collaboration with the International Commission on Radiological Units and Measurements; invited reports on disposal of radioactive wastes in oceans and seas; decided to further consider genetic effects of radiation; and sought further information from governments on these and other pertinent subjects.

The committee also prepared its first yearly progress report to the General Assembly. A final report is to be submitted by July 1958.

Much of the session's work was carried on in working groups, which considered effects of small doses of radiation, radiological data—that is, measurements of natural and man-made radiation and calculations of radiation levels based on these measurements—measurement methods, and the genetic effects of radiation.

The committee noted the need for more research and data before final conclusions can be reached. The committee is continuing to obtain information from governments and specialized agencies. Radiological data submitted before 1 Feb. 1957 will be considered at the committee's next session.

The committee is also inviting governments to submit detailed descriptions of measurement methods; these will be made available to other governments upon request. It is also requesting the Secretary-General to assist in arranging exchange of standards and samples when requested by governments.

In relation to the possible ocean and sea disposal of radioactive wastes, the committee has invited UNESCO and FAO to prepare data arising from their present research programs in oceanography and marine biology. Governments are being invited to inform the committee, periodically through the Secretary-General, of any significant disposals of radioactive wastes from atomic energy installations.

Study of the biological effects of small doses of radiation is being urged by the committee as an important factor in its work in evaluating effects.

In addition to its requests for further information, the committee is proposing several specialized studies on various aspects of radiation effects. The hazard from radioactive strontium fallout and from industrial radioactive wastes is being studied and assessed. As calcium ingestion may influence uptake of radioactive strontium, FAO has been invited to assemble information on the calcium content of the diets consumed throughout the world. The fallout hazard resulting from tests of nuclear weapons continues to be a main subject of the committee's work.

Genetic effects of radiation were discussed at the present session, but detailed consideration was deferred to the next session. More information, some of which is already being prepared for the committee, will then be available.

The committee is proposing initiation of a technical study by specialized groups of ways in which medical exposures to radiation can be recorded and evaluated. The committee is also circulating a statement through the medical press urging the medical profession's cooperation in its work.

The committee will hold its next session in April 1957. The 15 nations represented on the committee are Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, Egypt, France, India, Japan, Mexico, Sweden, the U.S.S.R., the United Kingdom, and the United States. At the current session, Carlos Chagas (Brazil) was chairman and Zenon Bacq (Belgium) was vice chairman.

Intermedin

Research to determine the structure and synthesis of the various pituitary hormones, which already has led to Vincent du Vigneaud's notable work on oxytocin and vasopressin, continues apace. The most recent development of importance is the isolation by I. I. Geschwind, C. H. Li, and L. Barnafi of intermedin and their determination of its structure [*J. Am. Chem. Soc.* (5 Sept. 1956)].

Intermedin, which was obtained from the pituitary glands of pigs, is the hormone that stimulates the expansion of melanocytes. Long thought to be limited in occurrence to the lower vertebrates, in which the pituitary has a definite intermediate lobe, it has now been isolated from the posterior lobe of the pituitary in a mammal. (In mammals the posterior side of the oral pouch that grows into the anterior pituitary gland fuses with the posterior part which grows from the brain, so that the posterior lobe actually includes what in other vertebrates constitutes a separate intermediate lobe of the pituitary.)

The work reported by Geschwind *et al.* demonstrates that intermedin is a peptide consisting of 18 amino acids, of which no more than two are of any single variety. The most striking feature of the structural analysis is that a central sequence of seven amino acids (methionine, glutamic acid, histidine, phenylalanine, arginine, tryptophan, glycine) is identical with a corresponding sequence that has been found to occur in all corticotropins so far isolated from the anterior lobe of the pituitary. The presence of this sequence thus probably explains the melanocyte-stimulating activity of pure corticotropin preparations. The adrenal-stimulating activity of the corticotropins must in that case depend on the specific sequences of the six amino acids on one end of the central sequence or on the five on the other. One may conjecture that the syntheses of intermedin and of the corticotropins are closely related.—B. G.

Second Atoms-for-Peace Team Visiting Latin America

A ten-man mission, composed principally of nuclear scientists, is visiting six Latin American nations to participate in discussions of the scientific potential of peaceful applications of atomic energy in the respective countries, especially in the areas of radioisotope applications and nuclear research and training. The mission, sponsored jointly by the Department of State under its International Educational Exchange Program, the U.S. Atomic Energy Commission, and the In-

ternational Cooperation Administration, is visiting Chile, Peru, Ecuador, Colombia, Panama, and Costa Rica. A similar group made an orientation and survey tour last June that included Venezuela, Brazil, Argentina, and Uruguay.

Members of the group, in cooperation with local scientists, are holding unclassified discussions and delivering lectures on the following subjects: the application of radioisotopes to industry, medicine, and biology; nuclear educational and training programs, including research reactors; the organization and functions of atomic energy administrative organizations. Additionally, staffs of the respective U.S. embassies are being briefed on all aspects of the atoms-for-peace program. The mission is headed by Clark C. Vogel, assistant director of the AEC Division of International Affairs.

Reactor for Japan

The Atomic Energy Commission has issued a license for the export of a research reactor to Japan, the first such commercial transaction in the history of the U.S. private atomic energy industry. Notice of the license was filed with the Federal Register on 2 Nov. 1956. Interested persons have 30 days from that date to request a formal hearing on the issuance of the license.

The license was issued to the New York firm of Marubeni-Iida for export of a reactor, fueled by an aqueous solution of uranyl sulfate and operating at 50 kilowatts, for use in Japan by the Japan Atomic Energy Research Institute. Atomics International is manufacturing the reactor at its plant in Canoga Park, Calif.

Microcards for WMO's IGY Work

The World Meteorological Organization has awarded a contract to the Microcard Corporation of West Salem, Wis., to microcard the observations made by meteorological groups for the International Geophysical Year. These data will come from between 2000 and 2500 continental stations and weather ships. It is estimated that this will involve some 2 million forms reduced to 30,000 Microcards per set. This quantity of data incorporated in one set will store in 24 14- by 3- by 5-inch card-file drawers and occupy about 13 cubic feet of space.

The Microcard Corporation will establish a photograph branch in Geneva for the program to insure rapid production and close liaison with WMO. The period 1–5 Jan. 1957 has been designated as a trial period and all meteorological services have been requested to submit WMO standard forms covering this period for microcarding.

Another Voice on Radiation Effects

A comment on the effects of radioactivity has been published in a letter to the *New York Times* (31 Oct.) from William G. Cahan, assistant attending surgeon at the Memorial Center for Cancer and Allied Diseases. After citing various cases of cancer from radiation exposure —x-ray diagnosticians who used fluoroscopy in its early days, Hiroshima victims, a wild muskrat that had eaten water plants growing beside the river that flows past Plant X-10 at Oak Ridge, Tenn.— Cahan concludes:

"The addition of even the smallest amount of radiation (a known carcinogen) to the many causes of cancer which are still unknown, but which are undoubtedly present in our daily lives, may be enough to tip the scales. . . . It would seem apparent that with our present lack of factual knowledge about the potential genetic and carcinogenic properties of radioactivity we should suspend large-scale radioactive enterprises until our biological knowledge is more secure than it is at present: Only then can genuine safeguards be established."

AEC Offices Abroad

The establishment of U.S. Atomic Energy Commission offices in London and Paris has been announced. The commission has maintained a liaison office in Canada at Chalk River, Ont., for some time. Amasa S. Bishop of the commission's Research Division has been appointed to the Paris post, where he assumed his duties on 1 Nov. Edward L. Brady of the Knolls Atomic Power Laboratory, Schenectady, N.Y., will open the London office on about 1 Dec.

The commission representatives will assist in scientific and technical aspects of the rapidly expanding work related to the United States program for international cooperation in promoting the peaceful uses of atomic energy. Their duties will include liaison with the atomic energy authorities and technical staffs of the country to which they are assigned and expediting the day-to-day scientific and technical problems growing out of the U.S. bilateral agreements for cooperation in nuclear energy matters.

There are now in effect agreements with 30 nations. Accords with seven others await the formal exchange of notes or the expiration of the statutory 30-day waiting period before the Joint Committee on Atomic Energy. A number of amendments to original agreements are pending and negotiations are under way with additional nations for nuclear research or power agreements. The commission representatives also will assist the Department of State, the International Cooperation Administration, the United States Information Service and other agencies in nuclear energy matters.

Tranquilizing Drugs

The U.S. Public Health Service has announced the establishment of a new unit to assist in the development of scientifically sound research programs on tranquilizing and other drugs used in the treatment of mental illness. The new unit is called the Psychopharmacology Service Center; it is in the National Institute of Mental Health in Bethesda, Md. Jonathan O. Cole, has been appointed psychiatrist in charge of the center. He is a former member of the staff of the Division of Medical Sciences of the National Research Council, where he worked with its committees on psychiatry and stress.

Almost simultaneously, the Veterans Administration announced plans for a nation-wide evaluation of the new tranquilizing drugs in 37 Veterans Administration hospitals. The study is designed to answer questions of the drugs' effectiveness and toxicity, what dosage is desirable, and how long they should be administered.

The project will be directed by an executive committee of physicians from various VA hospitals, under the chairmanship of S. Theodore Ginsberg, chief of VA's Psychiatry Division. Two of the tranquilizing drugs now in clinical use will be studied in the first research program, which will involve about 1000 patients with acute and chronic schizophrenia. Preliminary results of the investigation are to be discussed at the VA's third annual conference on chemotherapy in psychiatry, 8–11 May 1957, at the Downey, Ill., VA Hospital.

News Briefs

■ It is reported that the satellite which the U.S.S.R. will send aloft during the International Geophysical Year will be about the same size, 20 inches across, as the satellite now being built in this country. However, it will be five times as heavy as ours and its orbit will begin further out in space (460 miles compared with 300). The Russian satellite also will require an initial push from its launching rocket of 1000 miles per hour more than the U.S. satellite.

■ Seventeen medical schools, 16 in the United States and one in Canada, have reported completion during 1955–56 of construction projects that cost $65 million. In the same period, 17 schools in

the United States and two in Canada have undertaken new construction projects that will cost approximately $45 million.

■ The Atomic Energy Commission has postponed until 10 Dec. a hearing to reconsider its conditional approval of a controversial private nuclear power project near Detroit, Mich. The hearing, on safety questions, had been scheduled for 13 Nov. The Power Reactor Development Company of Detroit is to build the plant.

Scientists in the News

WILLIAM SHOCKLEY, WALTER H. BRATTAIN, and JOHN BARDEEN have won the 1956 Nobel prize in physics for their work in developing the transistor. Their research was conducted in the Bell Laboratories, Murray Hill, N.J. Shockley left Bell last year to become director of the Shockley Laboratories of Beckman Instruments, Inc., Mountain View, Calif., and Bardeen resigned in 1951 to become professor of physics and electrical engineering at the University of Illinois.

Sir CYRIL HINSHELWOOD, a professor at Oxford University (England), and NIKOLAI N. SEMENOV, director of the Institute of Physics in Moscow (U.S.S.R.), will share this year's Nobel prize in chemistry for "their researches into the mechanism of chemical reactions." Beginning 25 years ago and working separately, the two men have dealt with essentially the same problem: the elucidation of the occurrence of chain reactions and their importance in connection with the phenomenon of explosion. It was not until after each had published several papers that Hinshelwood and Semenov came to know each other. This is the first time that a Soviet scientist has received a Nobel prize. Not since the selection of Ivan Pavlov, the physiologist, in 1904 has a Nobel award gone to a Russian living in Russia.

COLBY M. CHESTER, honorary chairman of the General Foods Corporation, has received the Frank H. Lahey memorial award for distinguished service to medical education by a layman. The presentation was made by former President Herbert Hoover at a recent dinner in Chester's honor given by the National Fund for Medical Education.

THOMAS E. MURRAY, a member of the Atomic Energy Commission, is the 1956 recipient of the peace award of the Catholic Association for International Peace. The award is presented annually to "an American whose outstanding achievements have helped further the Christian principles of justice and charity in international life." Murray was cited specifically as one who has consistently pointed out that the "use of force in warfare is subject to the moral law, that the dictates of conscience call for rational limits on the size and number of nuclear weapons."

Two appointments to the staff of the National Science Foundation have been announced. THOMAS O. JONES has been named assistant to the head, Office of Scientific Information, and JACOB PERLMAN is the new study director for surveys, Office of Special Studies. Jones joins the foundation from Haverford College, where he has served for nearly 20 years as professor of chemistry and part of the time as department head. Perlman has been with the United Nations, where he has been principal statistical adviser in charge of a mission working with the Statistical Center of the University of the Philippines in Manila.

STANLEY E. KERR, professor of biochemistry at the American University of Beirut, Beirut, Lebanon, is spending a year as an A. D. Williams visiting professor in the department of biochemistry at the Medical College of Virginia.

E. L. DEMMON, director of the U.S. Department of Agriculture's Southeastern Forest Experiment Station, Asheville, N.C., has retired. He is succeeded by JOSEPH F. PECHANEC.

ZABOJ V. HARVALIK, professor of physics at the University of Arkansas, has taken a leave of absence to serve as director of the newly formed Basic Research Group at the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va. In addition to his work at Belvoir, Harvalik also will direct and evaluate several contributing research programs being performed by other scientific institutions and universities throughout the country.

A native of Yugoslavia, Harvalik was educated in Czechoslovakia, where he served as a professor of physics at the University of Prague. He became a naturalized U.S. citizen in 1945.

RAYMOND C. MOORE, professor of geology at the University of Kansas, has received the Hayden Memorial geological award of the Academy of Natural Sciences of Philadelphia. The award is given for the "best publication, exploration, discovery or research in the science of geology and paleontology, or in such particular branches thereof as may be designated." Moore has published three textbooks and about 200 scientific articles.

LUIS AVELEYRA ARROYO DE ANDA has been appointed director of the National Museum of Anthropology in Mexico. He is well known to American students, to whom he has for a number of years extended generous and competent assistance. He is also well known for his leadership, along with Maldonado, in the discovery in the Iztapan area of two mammoths and associated dart points indicating the existence of early man.

ROBERT F. MEHL, dean of graduate studies at Carnegie Institute of Technology, will receive the 1956 Pittsburgh award of the Pittsburgh Section of the American Chemical Society at a dinner in his honor on 12 Dec. This award is made annually for outstanding contributions to the advancement of chemistry in the Pittsburgh area.

At the recent dedication of Temple University's $12-million medical center, the following medical educators received honorary degrees: FRANKLIN D. MURPHY, chancellor of the University of Kansas; ISIDOR S. RAVDIN, professor of surgery at the University of Pennsylvania; WILLIAM S. MIDDLETON, head of medical services of the Veterans Administration Hospitals; FRANCIS R. MANLOVE, director of the University of Colorado Medical Center; MANSON MEADS, Bowman Gray School of Medicine; WILLIAM B. WOOD, JR., Johns Hopkins University; ALEX J. STEIGMAN, University of Louisville; DAVID S. RUHE, University of Kansas School of Medicine; and GEORGE W. CORNER, Rockefeller Institute for Medical Research.

Recent Deaths

HAROLD L. AMOSS, Greenwich, Conn.; 70; former professor of medicine at Duke University; 2 Nov.

FARRAND N. BENEDICT, Parsippany, N.J.; 76; vice president and chief engineer of the Crimmins Contracting Company; 3 Nov.

WILLIAM L. BURGOYNE, Lake Success, N.Y.; 58; consulting aeronautical engineer; 8 Nov.

ANDREW A. DICK, Los Angeles, Calif.; 53; former professor of surgery at Loyola University (Chicago); 2 Nov.

G. LYMAN DUFF, Montreal, Canada; 52; dean of the faculty of medicine at McGill University; 1 Nov.

HARRY G. V. EVANS, Caldwell, N.J.; 32; research chemist at Thomas A. Edison, Inc.; 3 Nov.

VLADIMIR P. FILATOV, Odessa, Russia; 81; director of the Ukranian Research Experimental Institute for Eye Diseases and Tissue Therapy; 30 Oct.

SUSANNA HAIGH, New York, N.Y.; 64; former faculty member of the New York Psychoanalytic Institute; 7 Nov.

FRITZ HOFFMAN, Hanover, Germany; 89; inventor of synthetic rubber, who had to decline the Nobel prize for his development on order of the Nazis; 31 Oct.

HARVEY J. HOWARD, Clearwater, Fla.; 76; former head of ophthalmology at the University of Canton Medical School; 6 Nov.

ALBERT G. KELLER, New Haven, Conn.; 82; professor emeritus of the science of society at Yale University; 31 Oct.

LUTHER C. SCOTT, Toledo, Ohio; 92; professor emeritus of geology at the University of Toledo; 31 Oct.

Sir FRANCIS SIMON, London, England; 63; physicist, professor of experimental philosophy at Oxford University and head of Clarendon Laboratory; 31 Oct.

Education

■ High-school teachers of biology who are especially interested in improving laboratory and field work in secondary-school biology courses are invited to apply for appointment to a group that will prepare a source book of laboratory and field studies for such courses. The project is sponsored by the Committee on Educational Policies of the Biology Council, Division of Biology and Agriculture, National Academy of Sciences–National Research Council, and by Michigan State University, with the support of grants from the National Science Foundation. The source book will be developed at an 8-week writing conference, to be held 24 June to 16 Aug. 1957, at Michigan State University.

Despite their importance in high-school biology, laboratory and field study are often pedestrian and unimaginative. One way to improve the situation is to supply teachers with a collection of superior exercises, realistically adapted to high-school situations. All teachers could then use procedures developed by particularly capable teachers. This is the purpose of the source book, which will contain a series of complete exercises from which individual teachers can draw ideas, studies for particular topics, or the laboratory and field work for entire courses.

The material will be developed by a group of 20 high-school teachers and 10 college and university biologists. The latter group is already selected. The prime requirement for participants is a creative, imaginative approach to laboratory and field studies. All interested high-school biology teachers are invited to apply. Biologists and school administrators are also urged to submit the names of teachers who are well qualified for the assignment.

Each applicant or nominee will be sent a form asking for information on his background and experience and evidence of his ability to contribute to the preparation of the source book. The final selection will be made on the basis of two essays submitted by each applicant who passes a preliminary screening. One essay will illustrate how a topic supplied by the committee can be converted into a study for high-school use; the other will present an exercise that the teacher has devised.

The essays will form a part of the pool of ideas for the source book. Manuscripts so used will be credited to their authors, who may thus appear in the publication even if they are not selected to participate in the conference. The writing team also will have access to other collections of exercises, including those gathered by the committee in preparing a series of source books of laboratory and field studies for college courses in the biological sciences.

Each participant will receive a stipend of $1000. His round-trip travel expenses between his home and East Lansing, Mich., will also be paid. From the stipend he will be expected to pay his own living expenses during the conference. The university will provide housing and dining facilities at reasonable prices for teachers and their families. The conference will be directed by C. A. Lawson, head of the department of natural sciences in the Basic College at Michigan State.

Completed applications should be submitted by *31 Jan. 1957*. All correspondence concerning the project should be addressed to: Committee on Educational Policies, Division of Biology and Agriculture, National Research Council, 2101 Constitution Ave., NW, Washington 25, D.C.

■ The Committee on Reactor Materials of the Atomic Industrial Forum, New York, has announced that a concentrated 2-week course on reactor materials will be held at New York University from 26 Nov. to 7 Dec. As in the case of an earlier course at Northwestern University last January, lectures will be presented by outstanding scientists on properties, technology, and applications of reactor materials.

Cochairmen for the course are Lyle Borst, chairman of the N.Y.U. physics department, and David Gurinsky, head of the metallurgy division at Brookhaven National Laboratory. Participation will be limited to 60 persons. Tuition for the course is $125 and does not include transportation expenses, hotel accommodations, or living expenses.

■ Wabash College has received a 180-acre tract of woodland from the estate of W. C. Allee. Allee served for 30 years on the faculty of the University of Chicago, from which he retired as professor of zoology to teach for five more years at the University of Florida, where he was chairman of the biology department.

As one keenly interested in the relationship between environment and living things, it was Allee's wish that the tract, which is near Turkey Run State Park, be kept inviolate. The college has agreed to follow this wish for 99 years. During this period records will be kept of the changes in the animals and plants on the tract. The president of Wabash has appointed a committee to look after the land and to plan ecological studies.

Grants, Fellowships, and Awards

■ The National Science Foundation, Washington 25, D.C., will award individual grants to defray partial travel expenses for a limited number of scientists who wish to attend the following international meetings sponsored by the International Union of Pure and Applied Chemistry.

Second International Congress on Surface Activity, London, England, 8–12 Apr. 1957; application deadline, *1 Jan. 1957*.

International Symposium on Purity Control by Thermal Analysis, Amsterdam, Netherlands, 24–26 Apr. 1957; application deadline *1 Jan. 1957*.

Sixteenth International Congress on Pure and Applied Chemistry, Paris, France, 16–23 July 1957; application deadline *1 Feb. 1957*.

■ The Association of Official Agricultural Chemists has announced the establishment of the Harvey W. Wiley award for analytic methods. The award honors the memory of the founder of the federal pure food and drug laws, who was also one of the founders of the association.

The $500 award will be presented annually to the scientist or group of scientists who make an outstanding contribution to development of methods of analysis of foods, cosmetics, drugs, feeds, fertilizers, pesticides, and soil, as well as for methods in general analytic chemistry. The first award will be given at the 71st annual meeting of the association in October 1957. All scientists, whether members or nonmembers of the AOAC are eligible for the award.

■ The Atomic Energy Commission has established a program of special fellowships to encourage more students to pursue courses of study in the physical sciences and nuclear engineering. The fellowships are part of the commission's

general program of assistance in the field of education for the purpose of alleviating the shortage of trained nuclear scientists and engineers.

The new program will be administered by the Oak Ridge Institute of Nuclear Studies, under the supervision of the Oak Ridge Operations Office of the commission. The institute now administers the AEC's special fellowships in radiological physics, the special fellowships in industrial hygiene, and the ORINS graduate fellowship program.

Applications will be processed before 1 Mar. 1957. About 150 fellowships, carrying stipends of $1800, plus tuition and dependency allowances, will be awarded to students registered in, or accepted by, a college or university where a program of graduate study in nuclear energy technology has been developed that is comparable to the 1-year course of study at AEC schools. Because of the time required to review applications and select fellows, it is expected that only a limited number of fellowships will be awarded for studies in the current academic year.

Fellowships will be awarded on a 1-year study basis and options to renew them for an additional year will be considered only under special circumstances. The final selection of candidates will be made by a committee of representatives of ORINS and the commission. Details of the program, including the criteria for acceptance of candidates, will be announced later.

■ The National Wildlife Federation has announced that there will be available for the school year 1957–58 a series of graduate fellowships and undergraduate James Hopkins scholarships in conservation education. Application for these fellowships and scholarships must be on file at the office of the National Wildlife Federation, 232 Carroll St., NW, Washington 12, D.C., *by 13 Dec. 1956*. An applicant's research program must have the approval of a director or departmental head of the applicant's university.

The scholarship funds are available to exceptionally well qualified students and may be used for the normal expenses of an undergraduate. The fellowships are designed to support research studies in the field of conservation education. Awards will be made to individuals who can show records of accomplishment in this field and who are qualified for, and preferably accepted for, graduate school studies.

These fellowships and scholarships are supported in part by the sale of the Wildlife stamps issued annually by the National Wildlife Federation, by a permanent grant yielding a limited endowment, and by other income available to the federation, the amount of which cannot be determined before the beginning of the year. Awards granted in the past have ranged from $500 to $1000.

■ The International Academy of Proctology has announced its annual prize contest for 1956–57. The best unpublished contribution on proctology or allied subjects will be awarded $100 and a certificate of merit. Certificates also will be awarded to physicians whose entries are considered of unusual merit. This competition is open to all physicians in all countries, whether or not they are affiliated with the academy. Entries of not more than 5000 words, typewritten in English, must be submitted in quintuplicate, *before 1 Feb.* to the International Academy of Proctology, 147–41 Sanford Ave., Flushing, N.Y.

■ The U.S. Public Health Service has announced that awards of more than $700,000 for a 4-year investigation into the causes of cerebral palsy and mental retardation have been made to the Yale University School of Medicine and to Brown University. These awards mark the beginning of a large coordinated research program which, during the next 10 to 20 years, will attempt to identify factors responsible for such disorders as cerebral palsy, mental retardation, blindness, and deafness.

Brown and Yale universities are the first of a dozen or more institutions that are expected to join in this research program. Yale's grant for the first year is $107,799; Brown is receiving $97,633. Under present plans, more than $1 million yearly will be awarded to medical institutions under the program, which will be conducted by the National Institute of Neurological Diseases and Blindness.

In the Laboratories

■ The Carbide and Carbon Chemicals Company, a division of Union Carbide and Carbon Corporation, has announced plans for a new development laboratory. The facilities, when completed in mid-1958, will bring together a majority of the scientists and engineers now working in the separate buildings of Carbide's development laboratories in South Charleston, W. Va. In recent years, the Chemicals Company has launched an average of 15 new chemicals a year; it also produces plastics and resins marketed by Bakelite, another division of Union Carbide. Last year the two divisions accounted for nearly 50 percent of the corporation's $1.187 billion sales.

The development department, for which the new facilities are being built, is concerned with turning laboratory chemicals into commercial products and in developing feasible industrial processes. Its staff is made up of organic chemists, physical chemists, and chemical engineers. The new center will include a main laboratory building, a high-pressure laboratory building, a plastics pilot scale building, and separate facilities for studies utilizing gamma radiation and radioactive tracers.

■ To consolidate and expand programs of basic research in the fields of chemistry, physics, and nuclear energy, the Mine Safety Appliances Company, Pittsburgh, Pa., has formed a new wholly owned subsidiary, the MSA Research Corporation. The new organization will handle basic research projects for the parent firm as well as for MSA's domestic and overseas subsidiary and affiliated companies. In addition, it will perform similar activities under contracts with government agencies and private industry.

Principal laboratories of the research firm will be at Callery, 30 miles north of Pittsburgh. C. B. Jackson has been selected to serve as vice president and director of research. He has been research director of MSA's operation at its Callery, Pa., plant and of a subsidiary, the Callery Chemical Company.

■ An Air Force contract for $2,229,970 has been awarded to North American Aviation, Inc., by the Air Matériel Command for research to determine the adaptability of new titanium alloys for supersonic aircraft and missiles. This is the first separate titanium research contract ever awarded the company, which has previously done such research as part of its regular airplane production contracts. The work will be done in the firm's Los Angeles plant.

The contract will run for 3 years and will involve the testing and evaluation of new titanium alloys that with heat treatment can reach a tensile strength of 170,000 to 180,000 pounds per square inch. This represents a 40- to 50-percent increase in strength over titanium alloys now in use. The research group hopes to form these new alloys in a soft condition, when they will be as easy to work as present low-strength alloys, and then heat-treat them to get high-strength properties. This technique has been used on steel and aluminum for many years.

■ Construction has begun on the Plum Brook Research Reactor Facility of the National Advisory Committee for Aeronautics, near Sandusky, Ohio. The new facility will be used by NACA in the study of problems of aircraft nuclear propulsion systems. The reactor unit will be staffed and operated by the NACA Lewis Laboratory, of which it is a part.

Reports

Use of Acridine-Orange Fluorescence Technique in Exfoliative Cytology

This is a preliminary report of a fluorescence-microscopic technique that permits rapid scanning in exfoliative cytology and promises increased insight into cytochemical changes leading to malignancy.

It is generally agreed that the Papanicolaou technique (*1*), notwithstanding its high diagnostic value, is demanding in terms of time (*2*) and does not reveal certain cytochemical properties presumably important in malignancy (*3*). Among a variety of supplementary techniques, several attempts to introduce fluorescence microscopy have been made (*2, 4–6*). The proposed methods have not been widely used because the techniques are not simpler than the routine Papanicolaou (*4*), because they do not differentiate between DNA and RNA and ask for special devices (*2, 5*) or because apparently they were not developed for diagnostic purposes (*6*).

Bertalanffy and Bickis (*7*) have described a fluorescence technique using AO (*8*), which allows for differential staining of the two nucleic acids: RNA in the cytoplasm and nucleolus gives a bright red fluorescence; DNA of the chromatin fluoresces green. The advantages of this method are (i) the simplicity and rapidity of the procedure; (ii) its applicability to living, supravital, and fixed tissues and smears; (iii) the distinction of the nucleic acids whose importance in carcinogenesis is undisputed; (iv) the brilliance of the picture obtained, allowing for evaluation of the morphological pattern as well as quick scanning under low magnification.

The method has now been applied to vaginal and cervical smears and to various types of malignant growth. Smears taken by the routine procedure, avoiding all contact with lubricants, are fixed immediately in equal parts of 95 percent ethyl alcohol-diethyl ether mixture for at least 1 hour. They are passed through alcohol 80, 70, 50 percent and distilled water, rinsed five times in 1 percent acetic acid, washed in distilled water, and stained for 3 minutes in AO (Gurr) (0.01 percent in buffer solution of 1/15*M* phosphate buffer at *p*H 6.0) at room temperature. The AO stock solution 0.1 percent is kept in the dark, and fresh dilutions are prepared once a week. The buffer is kept under refrigeration. After the preparation has been destained for 1 minute in the phosphate buffer, it is differentiated with 0.1*M* $CaCl_2$ for 30 seconds or more, until a clear outline of the nuclear structure is apparent. After a quick check under the fluorescence microscope, the slides are washed with phosphate buffer and mounted in a drop of the same buffer, with careful blotting. If it is desired, the smears may afterward be destained by transfer into 1 percent acetic acid for a short period and be processed with the standard Papanicolaou technique for comparison purposes.

The Zeiss-Winkel blue light assembly (*7*) was used. Microphotographs on Kodachrome A film give an excellent reproduction of colors.

The AO picture was checked by application of RNase (*7*) and was compared with the corresponding pictures obtained with the standard Papanicolaou technique, the fluorescence methods (*2, 4*), and toluidine-blue staining (*9*).

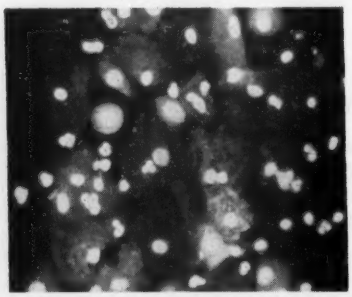

Fig. 1. Group of cells from a normal vaginal smear. Precornified squamous cells predominant, two cornified squamous cells (smaller nuclei) on the extreme right and left of the picture; inner basal cells are distinctive through their round shape, intensely fluorescing cytoplasm and large nuclei; in the lower part of the picture four outer basal cells (cytoplasm more abundant and less dense than in inner basals). Throughout the picture brilliantly fluorescing nuclei of leucocytes and lymphocytes are seen, also superimposed bacteria. 325 ×.

Elements of normal vaginal and cervical smears give the following fluorescence picture (Fig. 1) (*10*). *Cornified squamous cells*: cytoplasm greenish-gray with faint orange tinge; nuclei brilliant whitish green. *Precornified cells*: cytoplasm same as cornified, nuclei white-green to white-yellow with distinct white chromatin particles. Around the nuclei of some precornified cells orange granules (probably keratohyaline) of different size were seen, the largest approximating one-third of the size of the nucleus. *Intermediate or navicular cells*: cytoplasm with thickened cytoplasmic membrane of a faint orange color, nuclei white-green. *Outer basal cells*: cytoplasm reddish-brown (brick) color, dull, nuclei white-yellow with white chromatin particles. *Inner basal cells*: cytoplasm reddish-brown (brick) color with fine red particles (sometimes orange-reddish of much more intense hue than in outer basals), nuclei white-yellow with white chromatin particles and sometimes orange nucleoli. *Endocervical cells*: cytoplasm reddish-orange with meshlike appearance, nuclei white-yellowish with white chromatin particles and bright orange-red nucleoli. *Leucocytes*: brilliantly fluorescent white-green nuclei, lymphocytes and monocytes sometimes showing a faint greyish rim of cytoplasm. *Red blood cells*: unstained. *Histiocytes*: cytoplasm greyish, sometimes with orange particles (ingested bacteria), nuclei whitish-green of characteristic bean shape. *Mucous threads*: stained whitish-green. *Bacteria*: bright orange. *Trichomonas vaginalis*: stained bright orange with the nucleus outlined at the anterior end.

Most of the exfoliated *malignant cells* obtained in vaginal and cervical smears from cases of squamous-cell carcinoma of the cervix and the vagina yielded a fluorescence picture which was strikingly different from that of normal epithelial cells. These cells showed brilliant orange-red cytoplasm of a very intense hue and intensely yellow-fluorescent nuclei with brilliant orange-red nucleoli.

Preliminary studies of *malignant tumors* were made with carcinomas of the uterus (exfoliated smears), stomach, rectum, breast, lung, lymph nodes (metastatic) (touch preparations). The majority of malignant cells also showed intense fluorescence, orange-red in the cytoplasm and yellow in the nuclei, making them easily distinguishable from the cells of origin.

In general, the AO technique showed under *low power* the malignant cells in brilliant colors, thus calling the immediate attention of the examiner; under *high power*, since the fluorescent colors strongly enhance the contrasts, an excellent evaluation of morphological criteria was possible.

The technique suggests itself for rapid

scanning, to be followed, if necessary, by examination under high power and other procedures for differential diagnosis of the suspected cells.

An extensive investigation of vaginal and endocervical smears, with particular attention directed to nonmalignant proliferative and malignant processes, is at present being carried through. Also the applicability of the AO technique to cell suspensions and wet preparations is under investigation. Other papers giving results, as well as a more detailed description, are in preparation (*11*).

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10. Black-and-white photographs show neither the brilliance nor many details easily visible in the fluorescence picture. Some color photos are reproduced in 7.
11. We take pleasure in thanking Leo Kaplan, head of the pathology department of this hospital, for his valuable contribution of material and pathological diagnosis.

12 September 1956

Consistent Running Records

The two articles by M. H. Lietzke (*1, 2*) on track and other athletic records follow closely the pattern developed by previous workers in the study of the time-distance relationship. A particularly close parallel is to the pioneer work of A. E. Kennelly (*3, 4*), who plotted a straight-line log-log curve for all the activities Lietzke studied (men and women running, walking, swimming, skating, rowing; horses running, trotting, and pacing; men bicycle-riding and automobile-driving). Like other students besides Kennelly (*5–9*), Lietzke worked out a series of consistent performances (limited to men's running records) (*2*) by choosing a set of "best efforts" (220-yard, 1-mile, and 1-hour runs) that fit his curve. He then calculated the change in existing records required to reduce the times so that they would fall on the log-log straight line. Many of the calculated times are not consistent with history and experience in track athletics (Table 1), the best example being the present 1-mile record of 3 minutes, 58 seconds (3:58) and Lietzke's calculated 2-mile record of 8:22 (fractions of seconds are purposely omitted in this discussion).

The 1-mile record has been reduced in the past 50 years by more than 17 seconds, and during the same period the 2-mile record has come down about 36 seconds, with the interim marks keeping step with each other. To argue that the 2-mile distance will never be run in 8:22 would be extremely rash, but it can be predicted with reasonable certainty that the man who establishes the 8:22 mark will be able to run a mile in 3:54 or under.

A. W. Francis (*7*), using the records of 1943 when the 1-mile record was 4:02.6 and the 2-mile was 8:47.8, computed from his formula for a hyperbola that the time for the mile should be 3:58.7 and for the 2-mile 8:37.2, both slightly higher than present figures, but consistent with track history.

I was convinced many years ago (*6*) that the straight-line log-log function did not accurately fit the facts. Kennelly (*3, 4*), whose early work has never been fully appreciated by track specialists, was careful to call his logarithmic formula "An approximate law of fatigue in running animals." A modern student will be startled to find that exactly 50 years ago, Kennelly (*3*) calculated from his straight-line log-log relationship that the mile could be run in 3:58.1, but the prediction loses its force because his formula also equated this 3:58 mile with a 50.1 quarter mile run and a 23-second 220-yard run, both about 7 percent slower than the then-existing records. Lietzke, and others before him, have avoided these obvious inconsistencies by plotting their curves through the best marks only, but the inconsistencies still show in the calculated records if the attempt is made to squeeze the relationship into a straight-line log-log formula.

Table 1. Relationship between 1-mile and 2-mile running records for various dates.

Date	Record (min : sec)		Remarks
	1 mi	2 mi	
1905	4:15	9:09	
1931	4:10	8:59	Both records held by Paavo Nurmi.
1937	4:06	8:53	No great 2-mi runner in this period.
1944	4:01	8:42	Both held by Gundar Haegg (2-mi later reduced to 8:40).
1955	3:58	8:33	Iharos, the 2-mi record holder, has run 1500 m in 3:40.8.

A definitive time-distance relationship for athletic records must be based on a full knowledge of the history, experience, and practice in the various events and probably on physiological considerations as well, rather than on statistical data only. The research of Franklin M. Henry (*10, 11*) may lead to a formula that satisfies all these requirements.

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21 August 1956

George P. Meade is right when he mentions that a definitive time-distance relationship for track records should probably be based on physiological considerations as well as statistical data. The work of Franklin M. Henry in which an attempt is made to analyze the various biochemical factors that enter into a rate equation for running seems to me to be the correct approach to this problem. When the rate-determining processes that occur in the body during running have been sufficiently elucidated, it should be possible to derive a rate equation that will fit the pattern of observed records very closely at all distances.

In the absence of a rate equation that generated closely the pattern of the rate-versus-distance plot for all running events, I used the log-log relationship in my own calculations of the consistency of present racing records. The log-log plot seems to fit the observed records over a wider range than any other single relationship. However, the use of the log-log plot is most certainly an oversimplification. A plot of the rate equation based on physiological considerations may remove the inconsistencies that Meade has pointed out. It would be very nice if Franklin Henry could reach the point in the derivation of his rate equation where he could suitably isolate the various combinations of rate-determining biochemical reactions that occur in the body as a function of the distance run so that the shape of the rate curve could be determined prior to any consideration of the actual records. Whether this can be done remains to be seen.

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26 September 1956

Survival of Amino Acids in Marine Sediments

Proteinaceous material is carried into marine sediments upon the death and burial of aquatic organisms. The fate of this material has been a subject of conjecture, most investigators believing that it is rapidly decomposed (*1*). Studies of the thermal stability of an amino acid have recently shown that these compounds may survive intact for a long time at ordinary temperatures (*2*). In addition, protective mechanisms may play a part in preserving protein from early microbiological decomposition in terrestrial and marine muds. Recent work (*3*) has demonstrated the formation of complexes of protein with lignins and with clays, which are resistant to attack by microorganisms. Traces of proteins or peptides have been detected in fossil clams from the Pleistocene (*4*), and amino acids have been found in invertebrate and vertebrate fossils as old as the Ordovician (*2*).

In the present work, the amino acid content was determined for a typical recent shallow-water, marine deposit and for a similar sediment laid down during the Oligocene, approximately 30 million years ago. The recent sample was collected by coring on the inner continental shelf of the Gulf of Mexico and represents a narrow sedimentary layer at a depth of approximately 120 cm; this is below the zone of major bacterial activity (*5*). The age of the sediment is probably not more than a few thousand years. The ancient, or Oligocene, sample comprised a section of a marine shale core that was cut from the lower Anahuac formation in Fort Bend County, Tex., at a depth of 5000 ft.

Table 1. Comparison of a Recent and an Oligocene marine mud.

Content	Recent	Oligocene
Carbonate carbon (%)	0.71	1.49
Organic carbon (%)	0.53	0.27
Organic nitrogen (%)	0.044	0.032
Amino acids (μ mole/g)*	3.0	0.51
Principal amino acids in order of decreasing abundance†		
Identification certain	valine +++	alanine +++
	leucines +++	glutamic acid ++
	alanine ++	glycine +
	glutamic acid ++	proline +
	aspartic acid ++	leucines +
	glycine ++	aspartic acid < +
	proline ++	
	tyrosine ++	
	phenylalanine +	
Identification tentative	arginine ++	valine +

* For an amino acid mixture, 1 μmole/g is approximately 0.01 percent.
† Order of abundance: +++, high; ++, medium; +, low.

Immediately upon collection, both sediment samples were frozen in dry ice. In the case of the shale sample, the outer portion of the core was removed by turning on a lathe while the core was still frozen; the center was then crushed, suspended in distilled water, and milled to yield a thin slurry. On freeze-drying, both the recent and ancient samples were reduced to a powder with a flourlike texture.

The two samples were hydrolyzed, and the solutions were freed of salts electrolytically and by passage through Dowex 50 cation-exchange resin. Amino acids in the salt-free concentrates were resolved by one- and two-dimensional paper chromatography, using t-butanol-water-formic acid and phenol-water-ammonia as irrigation liquids. Positive identifications of individual amino acids were obtained by comparison of R_f values, using pure amino acids for reference, and by means of specific color reagents—for example, ninhydrin, isatin, 1,2-naphthoquinone-4-sulfonic acid and 1-nitroso-2-naphthol.

Data in Table 1 show that the modern and ancient marine samples selected for study are quite similar with respect to concentrations of carbonate carbon, organic carbon, and nitrogen. In contrast, the concentrations of free or combined amino acids are less in the Oligocene sample by a factor of 6.

Despite the difference in concentration, the arrays of amino acids in the two samples, modern and ancient, are strikingly similar, with the exception of the absence of tyrosine, phenylalanine, and arginine in the latter. Tyrosine, containing a chemically reactive phenolic group, would not be expected to be as stable as the other amino acids under earth conditions. Phenylalanine and arginine, likewise, are among the less stable of these acids.

Hitherto the detection of amino acids in ancient material has been limited to fossil shells or bones. Little or nothing is known about finely grained marine sediments. Although shell fragments were not eliminated from the samples, amino acids were also obtained on alkaline hydrolysis, where the shell structure was not disintegrated. Using Abelson's values for ancient shells (*4*), it would appear that more than 80 percent of the amino acids are associated with the noncalcareous portion of the Oligocene sample. Thus the amino acids of living organisms, in addition to those in large fragments of bone and shell, also may survive for long periods of time.

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28 September 1956

On the Presence of Free Sugars in Filtered Lake Water

It has almost universally been assumed that simple organic nutrients do not constitute more than a minute fraction of the "dissolved" organic matter of lake and ocean water. The main evidence for this assumption is the fact that fresh-water and marine bacteria, when they are cultured in the laboratory, are capable of utilizing extremely small concentrations of organic nutrients (*1*). The only low molecular weight organic compounds that have been demonstrated to occur in filtered lake water are the vitamins thiamin (*2*), niacin (*3*), and biotin (*3*), each of which is present in concentrations less than 1 mg/m³. There is also evidence that free amino acids may be present in lake water (*4*), but the concentrations and identities of the amino

Table 1. Concentrations of free sugars in samples of filtered lake water and filtered controls (double-distilled water). Trace (*t*) is less than 0.5 mg/m³.

Sample	Date	Depth (m)	Vol. of sample (lit)	Sucrose (mg/m³)	Glucose (mg/m³)
L. Opinicon	1/6/55	2	20	5	2
Little Round L.	1/8/55	1	4	2	1
Little Round L.	1/8/55	9	4	4	2
Little Round L.	1/8/55	14	4	10	5
Control			4	t	0
Control			2	1.5	0
Control			2	0	0

acids are uncertain. The purpose of the present work to test the truth of the aforementioned assumption as applied to free sugars in lake water (*5*).

Water samples were collected from two lakes in eastern Ontario: Lake Opinicon, located near Chaffey's Lock, and Little Round Lake, located near Maberly. The former is a shallow eutrophic lake with no thermocline and a maximum depth of 10 m. The latter is an oligotrophic lake with a well-developed thermocline and a maximum depth of 16 m. The water samples were collected with a Kemmerer water sampler and filtered through Millipore HA filters to remove the seston (plankton plus detritus).

Filtration was completed within 12 hours of collection for the Little Round Lake samples, and within 30 hours of collection for the Lake Opinicon sample. Before and after filtration the samples were stored at 4°C in the dark. Toluene was added as a preservative after filtration. It was not added before filtration because of the possibility that dying cells might liberate sugars to the water. The filtered samples were deionized with Amberlite IR-120 and IR-4B resins and then concentrated to dryness in a vacuum at temperatures below 45°C.

The dry residues were taken up in 1 ml of water, and amounts ranging from 5 to 300 μlit were spotted on sheets of Whatman No. 1 filter paper. Standard amounts of known sugars were spotted beside the unknowns, and the chromatograms were developed with a butanol-ethanol-water (45/5/50) solvent (*6*) for 3 days by descending chromatography. Chromatograms were run in duplicate. After being dried, one was sprayed with a benzidine spray (*7*) and the other with 2 percent orcinol in 2*N* hydrochloric acid. The amounts of the individual sugars were estimated by comparing the color intensities of standard spots with those of unknowns at the same chromatographic position. The comparisons were made in ultraviolet light. In order to determine the contamination level during analysis three separate samples of double-distilled water were subjected to exactly the same procedure: one 4-lit sample and two 2-lit samples.

The results are presented in Table 1. Sucrose and glucose were the only sugars detected in lake water. Both sugars occurred in low and approximately equimolar amounts. There was evidence in Little Round Lake that increased amounts of free sugars were present in the hypolimnetic water (below 8-m depth). On the other hand, the distilled water controls contained barely detectable amounts of sucrose and no glucose.

Under the conditions used in these analyses, about 25 percent of the sucrose and glucose initially present would have been removed by the ion-exchange columns (*8*). We are not prepared to make any statement about the exact amount of free sugar in the "dissolved" organic matter of lake water but feel justified only in stating that the concentrations are of the order of magnitude of *n* parts per billion parts of water. These low concentrations do not negate the assumption under test.

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10 September 1956

Method for Predicting Amount of Strontium-89 in Marine Fishes by External Monitoring

If the total radioactivity in a whole fish could be determined by means of external monitoring, this information would be very useful to ecologists, fisheries biologists, and others. If such a method were found to be suitable for field work, it conceivably could eliminate much tedious dissecting, ashing, and counting procedures. During the course of some experiments on the uptake, accumulation, and loss of radiostrontium by marine fish, a record was kept of the counts per minute detectable at various external parts of the fish's body prior to dissection and analysis of the organs and tissues by conventional ashing and counting techniques. It was not known in advance whether or not these measurements would have any significance, but the possible occurrence of a direct relationship between some aspect of external monitoring and the total amount of radioactivity in the entire fish seemed worth investigating (*1*).

Several species of pelagic fish, including the black skipjack tuna (*Euthynnus yaito*), the yellowfin tuna (*Neothunnus macropterus*), and the dolphin (*Coryphaena hippurus*), were fed radioactive strontium-89 in gelatin capsules. The fish were kept in tanks with circulating sea water and were killed at intervals up to 27 days. A piece of pliofilm (Saran wrap) was used to cover the fish, and the probe of a count rate meter was used to determine the number of counts per minute on direct contact. The G-M tube used had a window thickness of 3.5 mg/cm², but it was protected by a screen that reduced its efficiency to some extent.

The various organ systems and tissues of the fish were subsequently analyzed for radioactivity. The total radioactivity recovered in each system—for example, the gills, axial skeleton, muscle—was then compared with the counts per minute (at 5-percent statistical error) that were previously found by monitoring the mouth, eye, operculum, gills, dorsal integument, and the pectoral, dorsal, and caudal fins. No apparent relationship was observed between any two parameters except that between the amount of radioactivity in the skeleton and the counts per minute found by monitoring the caudal fin. Figure 1 shows that the relationship between the number of microcuries of radiostrontium in the skeleton and the counts per minute in the caudal fin is approximately linear. Since about 30 percent of the radiostrontium found in the fishes after 7 hours occurs in the axial skeleton (*2*), it is therefore possible by measuring the counts per minute in the caudal fin to predict the total amount of radiostrontium in the entire fish.

This method proved successful only when the axial skeleton was found to have a radiostrontium content in excess of an undetermined threshold. Thus, a fish having 0.16 μc Sr^{89} in its skeleton showed only background radiation with the count rate meter, but a fish with 0.40 μc Sr^{89} had sufficient external radiation to be detected. The minimum Sr^{89} skeletal constant is therefore somewhere between

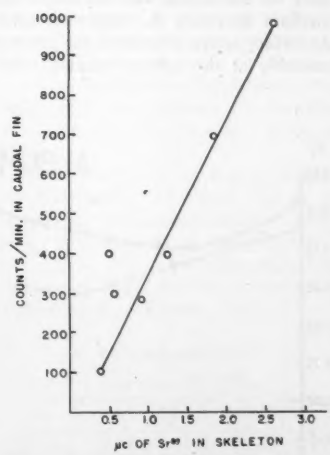

Fig. 1. Linear relationships between the counts per minute monitored in the caudal fin of tuna fed Sr^{89} and the microcuries of Sr^{89} found in the skeleton.

0.16 and 0.40 μc and probably represents the loss owing to self-absorption of the beta-particle energy. These values are, of course, valid only for the particular counting system used in this series of experiments. It is possible to make the detection system considerably more sensitive and, therefore, reduce the threshold value for skeletal strontium.

The afore-described method has not yet been tried with other fission products, and in particular, mixed fission products, such as might be encountered in an area following an atomic detonation or in a region into which nuclear power plant wastes are introduced. If a parameter such as that indicated in this paper could be used to predict the total amount of radioactive material in marine fish, it might be feasible to monitor a catch on the fishing vessel or at the canning factory and, thereby, possibly prevent radioactive fish from being consumed.

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9 August 1956

Protein Adsorption on Filter Paper

Protein adsorption on paper is one of the main obstacles in the determination of mobilities by paper electrophoresis, since ion interaction with the supporting medium decreases the migration rates. As surface-active substances, the proteins assemble at the solvent-cellulose interface, and their adsorption behavior will be determined primarily by electrostatic forces between the ion and the negative charge on the paper. The latter would be due to a selective absorption of oxyhydrilions from the medium, which accounts for the negative charge on most nonionogenic surfaces in water (*1*). Carboxyl groups that probably originate by an oxidation of primary alcohol groups during the paper manufacture (*2*) may also play a role in this connection. It follows that the paper charge, and the electroosmotic flow arising from the zeta potential thus produced, should increase with the *p*H. In fact, in electrophoretic analyses where dextran was employed to measure the electroosmotic flow (*3*), we found that the migration tended to increase in approximate proportion to the *p*H from *p*H 4.0 to 7.0.

Pretreatment of the paper in order to avoid adsorption has been attempted (*4*) but so far has not met with success. We therefore introduced, among other factors, a correction for this effect in the calculation of electrophoretic migration rates and found complete agreement between the mobilities determined by open-strip paper electrophoresis and those obtained by the Tiselius method (*3*).

Chromatographic R_f values were chosen to evaluate adsorption, since protein migration would not be subject to any forces other than the solvent displacement by capillary action (*5*). Ten microliters of dialyzed solutions of normal human albumin ($5 \times 10^{-4} M$) and gamma globulin ($2 \times 10^{-4} M$) were applied on 3- by 49-cm strips of Munktell paper No. 20/150 2,5 cm above the buffer level, after 18 hours of equilibration (*6*). Sodium and zinc acetate buffers of $\Gamma/2$ 0.045 were used as part of our studies on protein-zinc interactions, and the ascending chromatograms were developed for 120 minutes at 23°C, after which they were stained and scanned, as in electrophoresis. Each of the points recorded represents the mean of four determinations with a maximal variation of about 5 percent.

The R_f minima of albumin (Fig. 1) indicating maximal adsorption at *p*H 4.85 in sodium and at *p*H 6.00 in zinc acetate coincided with the isoelectric points in the same media as found in our electrophoretic analyses. This is in accordance with the early literature on this subject dealing with adsorption on collodium and charcoal (*7*). Gamma globulin, however, showed in sodium acetate a broad R_f minimum constant from *p*H 4.0 to 6.8, the upper limit of which roughly corresponds to the isoelectric point. Analogous results for immune globulin were obtained by Shepard and Tiselius (*8*) from studies on silica gel.

Under the conditions employed, gamma globulin was more strongly adsorbed than albumin in sodium buffer. The difference amounts to 4.5 percent at *p*H 5.0 and increases to above 10 percent toward the extremes of the experimental *p*H range. When, in order to establish conditions prevailing in the whole serum, 1 ml of albumin solution was added per 100 ml of buffer at *p*H 4.05, gamma globulin adsorption fell to the albumin level, evidently owing to a partial neutralization of the paper charges by albumin. The implications of this fact are discussed in another report (*3*).

The fundamental role of electrostatic interactions in adsorption is emphasized by experiments with a practically nonionized substance as dextran. Whereas for a 4-percent aqueous dextran solution we found R_f values of 0.98 ± 0.02 throughout the whole series, Tiselius (*4*) points out that salmine, which mainly bears strongly ionized cationic groups, is so firmly held by paper in electrophoresis that "tailing" impedes the observation of compounds with lower mobilities.

Moreover, when the electrostatic factor is stressed, the results indicate that the protein net charge is of secondary importance in the interaction with paper centers, which will be sustained by the cationic groups of the protein. The reason for the adsorption falling off in strongly acid media will thus be the low charge on the paper, and its decrease above the isoelectric point of the protein will be due to the diminution of the positive protein charge. Hence, adsorption will be maximal in a zone around the isoelectric point, where it could be further enhanced by the decrease of the zeta potential, which produces a lessening of the intermolecular repulsion.

The increment of positive protein charge by formation of zinc complexes may thus be considered the main reason for the difference between R_f values in zinc and sodium acetate. Adsorption at the same *p*H's was seen to be signifi-

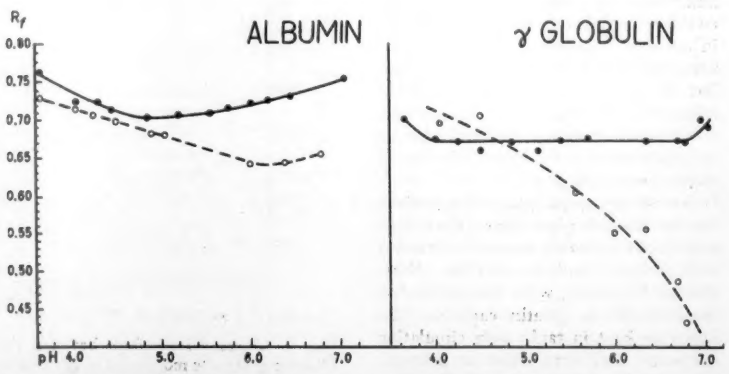

Fig. 1. R_f values of human serum proteins in sodium (●——●) and zinc (○- - -○) acetate as function of the *p*H.

cantly higher in the former, and the difference increased substantially above *p*H 5.0 toward the zone known to favor intense protein-zinc interactions.

After rigorous standardization of the experiments, the results were reproducible within 1-percent variation, and the values may be regarded as one of the physicochemical constants of a protein.

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27 August 1956

Peralta Complex—a Sonoran Variant of the Cochise Culture

Last year I reported on the examination of seven camp sites west of Hermosillo, Sonora, Mexico, that represented a prepottery, lithic complex very similar in type to the Cochise culture of southeastern Arizona (*1*). This material is most comparable to the San Pedro stage of the Cochise, which in Arizona has been dated approximately 3000 to 500 B.C.

During the summer months of 1955, as a research associate of the Instituto Interamericano, I instigated an archeological research program in western Mexico (*2*). The field survey was concentrated primarily along the coasts of Guerrero and Colima and in northern Nayarit; other limited investigations were undertaken in Michoacán, Guanajuato, Jalisco, and Sinaloa. Near the conclusion of the survey, several additional areas were investigated in western Sonora to complement previous studies; as a part of this survey, four of the principal Peralta sites were revisited.

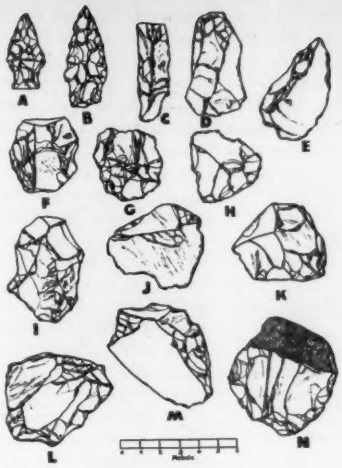

Fig. 1. Artifacts from the "Peralta" Cochise, Sonora: *A, B,* projectile points; *C, D, I,* end scrapers; *E, J, K, M,* single flakes; *F, G, H, L,* side scrapers; *N,* cobble end chopper.

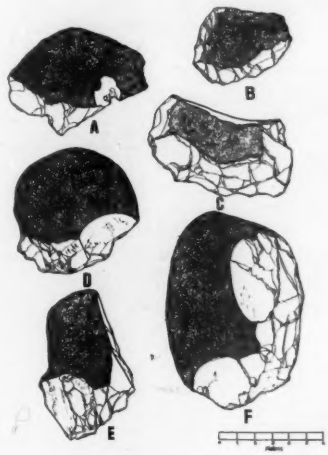

Fig. 2. Several examples of the cobble choppers, the shapes of which are similar to those of the southeastern California region.

During the original 1953 survey, seven camp sites were located, with the subsequent collection of 146 stone artifacts. These included percussion-flaked side and end scrapers, crudely flaked knife blades, large primary flakes, cobble choppers, and occasionally projectile points, the latter comparable to the San Pedro stage of the Cochise and to the Pinto-Gypsum points of California.

As a result of the 1955 investigation, another collection of 126 stone artifacts was made, primarily to collect all the available surface material before the possible loss of the sites to pending cultivation (Figs. 1 and 2).

In addition, three new, though skimpy, sites were located in the same area, and 36 more specimens were found. Thus, to date, a total of 308 artifacts have been collected from the entire site area. Scheduled plans for a 1957 survey will test-excavate several of the more important sites, and the entire surrounding region will be completely surveyed to ascertain the extent of the distribution of the material.

Surface finds made during the 1955 survey included material similar to that previously described in the preliminary report (*1*). However, in the second survey, I was fortunate to locate fragments of two metates, none of which had been encountered previously. These fragments indicate two milling types: (i) a shallow basin made of granite and (ii) a smaller, thin, flat slab made of shale. Numerous one-handed, asymmetrical, bifaced manos were found, during both seasons, scattered over most of the surface area.

A brief, preliminary tabulation of the variety of types of artifacts presently discernible from these ten sites is given in Table 1.

The artifacts will be deposited with the Biblioteca y Museo de Sonora in Hermosillo (Fernando Pesqueira, director), when the study is completed.

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Table 1. Types of artifacts.

Artifacts	Sites										Total
	A	B	C	D	E	F	G	H	I	J	
Metates			1	1							2
Manos (including fragments)		2	4	21	5	2	5		4	2	45
Projectile points			6	2	1	1	1				11
Knife blades			24	23	6	1					54
Scrapers	3		26	28	10	8	2	4	3	2	86
Crude primary flakes			8	11	16		6	7	2	1	51
Cobble choppers			5	12	9		2	2	4		34
Miscellaneous			2	15	2	1	2	2		1	25
Total	3	2	76	113	49	13	18	15	13	6	308

References and Notes

1. G. E. Fay, *Science* **121**, 777 (1955).
2. These archeological studies were conducted under the auspices of the Instituto Nacional de Antropología e Historia (Eduardo Noguera, director of the Dirección de Monumentos Prehispanicos) of Mexico City, and were financed in part by the American Philosophical Society of Philadelphia (Penrose Fund). James L. Bean, of Englevale, Kan., served as field assistant.

19 September 1956

Extraction of $C_{21}O_5$ and $C_{21}O_6$ Steroids from Aqueous Media

Although a great variety of solvents have been used for the extraction of corticosteroids, it seems, as has been pointed out by Mason (*1*), that "solvents have been chosen as a matter of personal preference rather than on the basis of any study of their merits and shortcomings." By and large, the chlorinated hydrocarbons have become the favorite solvents after the introduction of ethylene chloride as a selective solvent for cortical hormones by Cartland and Kuizenga (*2*). Although Reichstein (*3*) indicated the excellent extraction properties of ethyl acetate for corticosteroids, relatively little use has been made of this solvent until quite recently, when Meyer (*4*), after testing a variety of solvents for extraction of blood, found that ethyl acetate was particularly favorable, since it extracted smaller amounts of extraneous material and did not form emulsions.

Owing to its relative nonemulsifying properties, as discovered by Meyer, ethyl acetate was subsequently introduced for extraction of corticosteroids from guinea pig and human urine (*5–7*). In these studies, in which the more polar solvent ethyl acetate was used, the two $C_{21}O_6$ steroids 6β-hydroxycortisol and 2α-hydroxycortisol have been isolated. In this connection, the finding of corticosteroids with mobilities on paper of $C_{21}O_6$ steroids in adrenal extracts obtained by the use of ethyl acetate as the extracting solvent is noteworthy (*8*). The fact that in previous studies, in which methylene chloride was used, these $C_{21}O_6$ steroids were not observed except in trace amounts (*9*) has made it pertinent to study the extractability of $C_{21}O_6$ steroids from aqueous media.

In this report (*10*) partition coefficients of some $C_{21}O_5$ and $C_{21}O_6$ steroids for the two systems chloroform/water and ethyl acetate/water are presented (Table 1). The partition coefficients (expressed as $K = C_{org.}/C_{aq.}$) were determined by shaking the solvents containing the steroids (100 to 600γ) with an equal volume of water (5 ml). Solvents that were not previously saturated with respect to each other were used, since the partition coefficients were required for calculations on batch extraction with new solvent. The partitions were done at room temperature. Determinations were done on aliquots from each phase.

It appears from Table 1 that ethyl acetate is a better extracting solvent than chloroform for both the $C_{21}O_5$ and $C_{21}O_6$ steroids studied. From the partition coefficients of the $C_{21}O_6$ steroids given, it becomes clear that chloroform (similar data were obtained with methylene chloride) is not a suitable extraction solvent for these steroids. Since in the usual extraction procedure the original extract is further purified by washing with alkali and water to remove acidic interfering material, only small yields of $C_{21}O_6$ steroids can be obtained owing to the appreciable extraction by the water phase.

In view of the relatively low partition coefficients of some $C_{21}O_5$ steroids for the $CHCl_3/H_2O$ system, a reevaluation of the significance of earlier quantitative studies in which chlorinated hydrocarbons have been used will be necessary. Thus, the relatively small yields of 3α, 11β, 17α, 21-tetrahydroxypregnan-20-one isolated from human urine following cortisol feeding undoubtedly have been the result of the aqueous washes of the methylene chloride extracts during the extraction and fractionation procedure (*9*). The present data indicate the necessity for further work on extraction and separation of highly hydrophilic steroids, since increasing the polarity of the solvents decreases the extraction selectivity and presents greater difficulties in isolation.

Table 1. Partition coefficients of some $C_{21}O_5$ and $C_{21}O_6$ steroids.* The determinations were done by ultraviolet spectrophotometry in methanol with the Beckman DU (UV), by the phosphomolybdic acid (P.M.), or the Porter-Silber (P.S.) reactions as indicated.

No.	Steroid	K $CHCl_3$/ H_2O	K EtOAc/ H_2O	Determination method
1.	11β, 17α, 21-Trihydroxy-4-pregnene-3,20-dione	6.4	12.2	UV at 240 mμ; P.M. and P.S.
2.	11β, 17α, 21-Trihydroxy-4,6-pregnadiene-3, 20-dione	4.8	12.6	UV at 280 mμ
3.	11β, 17α, 21-Trihydroxy-1,4-pregnadiene-3, 20-dione	3.6	11.2	UV at 242 mμ
4.	3α, 11β, 17α, 21-Tetrahydroxy-pregnan-20-one†	2.4	11.0	P.M.
5.	11β, 17α, 20β, 21-Tetrahydroxy-4-pregnen-3-one	1.1	1.6	UV at 240 mμ
6.	11β, 17α, 20α, 21-Tetrahydroxy-4-pregnen-3-one	0.9	1.7	UV at 242 mμ
7.	6β, 17α, 21-Trihydroxy-4-pregnene-3,11,20-trione	0.3	2.2	UV at 233 mμ
8.	9α, 11β, 17α, 21-Tetrahydroxy-4-pregnene-3,20-dione	0.1	2.0	UV at 242 mμ
9.	2α, 11β, 17α, 21-Tetrahydroxy-4-pregnene-3,20-dione	0.3	1.9	P.S.
10.	6β, 11β, 17α, 21-Tetrahydroxy-4-pregnene-3,20-dione	0.05	0.9	P.S.

* Thanks are due to Karl Pfister, for steroids 1, 2, 4, 6, and 8, to the Schering Corporation, for steroid 3, to G. D. Searle & Co., for steroid 5, and to Franz Sondheimer, for steroid 7. Steroids 1–8 were crystalline and were chromatographically homogeneous in the toluene-propylene glycol and chloroform formamide systems. Steroids 9 and 10 represent noncrystalline chromatographic fractions I and II of guinea pig urine extracts previously shown to contain these steroids as major components (*6*).

† For unexplained reasons, variable results were obtained with steroid 4 during the chloroform-water partitions with low recoveries from the aqueous phase. The value given in the table represents the average of three determinations in which the total recoveries were above 90 percent.

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10. This work was supported in part by research grant NSF-G664 from the National Science Foundation. The technical assistance of Arline M. Tillotson and Bobby G. Young is gratefully acknowledged.
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14 September 1956

Book Reviews

Man in Search of His Ancestors. The romance of paleontology. André Senet. Translated by Malcolm Barnes. McGraw-Hill, New York, 1956. 274 pp. Illus. $5.50.

In Search of Adam. The story of man's quest for the truth about his earliest ancestors. Herbert Wendt. Translated from the German by James Cleugh. Houghton Mifflin, Boston, 1956. 540 pp. Illus. + plates. $6.50.

The revelation of the Piltdown hoax and, at the same time, the widespread publicity involving the numerous discoveries of man-ape remains in South Africa have apparently whetted public appetite for popular accounts of human evolution. The effects have been twofold: an increase in the willingness of magazines of mass circulation to give simplified, heavily illustrated versions of discoveries in human paleontology, and the multiplication of popular books dealing with the subject. Unfortunately the number of new and sensational finds can never keep pace with the artificially stimulated curiosity of the public. The result is, that although a certain amount of information may be successfully transmitted, much of this hastily composed literature tends to become repetitious and wearisome, as only stale and warmed-over facts can become.

Taken individually, many of these treatises are unexceptionable and useful works. It is in the mass that they present a certain monotony, which is inescapable and which, perhaps, encourages a kind of languor even in the authors, so that, for example, we find André Senet, in *Man in Search of His Ancestors,* confessing that his account of Darwinism and Lamarckism is "oversimplified." There thus emerges a sort of "why bother when the going gets tough?" attitude, which encourages the same reaction in the public.

There are annoying little expressions which begin to grate on the professional reader. The Old Man of La Chapelle has a brain that was "abnormally developed." Bishop Wilberforce and Huxley are dextrously manipulated into having their great debate over Neanderthal man. The tooth of *Gigantopithecus* is assigned without further warning to a "gigantic ape or man from 8 to 10 feet tall." Although this theory is no longer seriously held in reputable quarters, it has an irresistible attraction. *Meganthropus,* for example, is carefully calculated to have had a height of 7 feet 6 inches. The researches of Weidenreich on the brain are confused with the work of Robert Broom. Clairvoyantly, *Sinanthropus* is assigned a rudimentary language because of certain muscular insertions on the skulls. The American paleontologist Marsh becomes March.

When bunched, these statements look more appalling than when they are scattered through the book, which begins with the Piltdown hoax and runs quickly backward to the dawn of life itself. The attempt to enliven the story with material of the human-interest variety has produced some of the errors noted here. The general public, says Senet, "has acquired a few false notions." It is regrettable that this readable and by no means unappealing book will not do all that it might have done to reduce them.

Herbert Wendt, in his *In Search of Adam,* has produced a lengthier and, at the same time, more concentrated book. He has confined his attention primarily to the human story and has, a little more successfully and accurately than Senet, made use of American historical materials. Some of the European material is of particular interest to English and American readers, because it gives details of continental anthropologic history which have hitherto been less available to the general public.

Unfortunately, there are also dogmatic expressions upon still unsettled problems. The Swanscombe cranium is asserted, without proof, to be a "genuine early Neanderthal specimen" and the Piltdown *cranium,* as distinct from the jaw, to be a "direct ancestor or contemporary of the Aurignac or Cro-Magnon peoples." Wendt asserts that the mastodon was used as a draft animal by the Maya but that "it probably went out of fashion." One wonders, on the subject of "fakes," intentional and otherwise, why the relation of the famous *Hesperopithecus* tooth to the Bryan antievolutionary campaign and the Scopes trial could not have been told, since so much other interesting gossip has been introduced. Certainly the world laughed at the Scopes episode, but should we forget, we scientists, that in 1927 the public had a chance to laugh at the scholars and their "million-dollar tooth" as well?

Occasional expressions, once more, cause lifted eyebrows, even though they are well-intentioned. For example, Australia "drifted away" from the Asiatic mainland in Cretaceous times." When sexual selection was invoked to explain the rise of man, the objections "were not really significant." Once more an author bows out of a formidable problem.

In Search of Adam is an uneven popular treatment of a complicated subject. It is extensive and novel in its fullness of European detail. It will sell and be widely read. It contains, at the same time, apocrypha and dramatization after the best modern manner, which will sound a trifle dated in perspective. This is a fault of public taste, but unfortunately it seems to create an appetite which can be served only by more spectacular discoveries narrated in an increasingly breathless prose.

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Handbook of South American Geology. An explanation of the geologic map of South America. Geological Society of America Memoir 65. William F. Jenks, Ed. Geological Society of America, New York, 1956. 378 pp. Illus. + maps.

This volume is intended to accompany the geologic map of South America published in 1950. Because compilation of the handbook was delayed for several years, many of its chapters are more up-to-date than the map. Hence, the book serves both as a detailed explanation and as a supplement, bringing the map abreast of current geologic knowledge.

The book consists of chapters on the several South American countries, each written by a geologist or a group of geologists familiar with the particular area. Despite the multiplicity of authors, a good balance of subject matter is maintained, and the treatment of geologic details is remarkably uniform from one country to another. The editor should be highly commended for insuring this balance and essential uniformity, while at the same time permitting each author considerable individuality of presentation.

Emphasis is on stratigraphy and to a lesser degree on structure. Igneous rocks and land forms are treated very briefly in most of the chapters but are discussed at length in a few. Economic geology is omitted altogether in order to hold the book to reasonable dimensions. Most of the authors take pains to point out the

more important gaps in present knowledge—what geographic areas have not been sufficiently explored and what unsolved problems exist in the better known areas. Illustrations are limited to a few geologic cross sections, detailed maps of small areas, and maps designed to correct or to supply more detail to the large map. The list of references at the end of each chapter is short, but includes papers to which an interested reader can turn for more complete bibliographies.

The volume holds to its purpose as a handbook, attempting no more than a concise description of the rocks and structural features shown on the map. There is no effort to synthesize an over-all picture of the geology of South America or to relate South American geology to the rest of the world. This means that the book is hardly suitable for reading from cover to cover by anyone without previous knowledge of South American geology and place names. But as a reference book it is excellent, providing an authoritative and convenient means of getting information quickly about the geology of any South American country.

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Handbuch der Physik. vol. XIX, *Electrical Conductivity*, 1. S. Flügge, Ed. Springer-Verlag, Berlin, 1956. 411 pp. Illus. DM. 82.

This volume is one of a series constituting the *Encyclopedia of Physics* edited by S. Flügge. It consists of four chapters. Each chapter is beautifully done with very little overlapping of subject matter. Some overlapping is found: J. C. Slater's figure 42 and Harry Jones' figure 4 illustrating the displacement of the electronic wave packet when a metal is subjected to a potential gradient are the same but with different notations. Other cases of repetition appear but these are, in general, necessary for a complete treatment of the subject and are helpful to the reader.

The volume opens with a thorough treatment of the electronic structure of solids (136 pp.) by Slater, and may be considered a discussion of methods of solving Schrödinger's wave equation for a crystal consisting of nuclei and electrons. Slater chooses typical solids to illustrate the principles involved in finding the potential in which an electron moves and treats in detail the periodic potential problem. He traces this from the free-electron theory, through the tight-binding and cellular approaches, to the augmented plane-wave method and shows the limitations or advantages of each. He is very lucid in pointing out that the free-electron approximation, although it appears to agree with more elaborate methods of calculation especially in describing conductivity, is not a true representation of the situation. Slater also carefully points out that the complete solutions are involved and have not been carried through in actual cases, although he sees hope for this in the advent of modern digital computers.

Slater's treatment of electric conductivity hits the high points. He outlines the relation of energy-band theory to electric conductivity, to semiconductors, and discusses the impurity problem. He closes his chapter with a treatment of electron interactions and discussions of chemical bonds and magnetic properties of solids.

The second chapter (90 pp.) by A. N. Gerritsen deals with the conductivity of metals. The emphasis is on experimental methods and results. He discusses the effects of melting, pressure, lattice defects, magnetic transformations, and impurities on the electric resistivity of metals and gives correlations between conductivity and atomic numbers and electronic configuration of the elements. His discussion of the conductivity of anisotropic metal crystals permeates the whole chapter and is generally good. However, on page 140 he states that experimental results for a polycrystalline material agree with Voight's equation and yet on page 155 he states that no experimental values are available for polycrystalline material. Apparently, Gerritsen's view is that all metal crystals are quasiisotropic. This chapter's great merit lies in the compilation of accepted values for resistivity and temperature coefficients of resistivity of metals.

In the third chapter (89 pp.), Harry Jones gives a thorough mathematical treatment of the theory of electric conductivity including thermal conductivity. He discusses the statistical and wave theories of conduction and proceeds to calculate the resistivity of a metal based on the Debye and Einstein solid models. He discusses the thermoelectric and galvomagnetic effects. Also he does not overlook a discussion of the anomalous skin effect where the electronic mean free path exceeds the classical skin depth. This chapter is highly mathematical and profuse with derivations but is an ideal companion for Chapter 1.

The volume closes with photoconductivity (80 pp.) by G. F. J. Garlick. This chapter is written clearly and the various diagrams illustrating the conduction band, the filled band, the Fermi limit, and the forbidden gap for the electronic energy-band of a crystal are excellent, indeed. His discussion of the barrier-layer theory of photoconductivity is especially good. The photovoltaic and photo-electro-magnetic effects are also discussed. This chapter closes with a discussion of the photoconductivity of specific solids, inorganic and intermetallic compounds, and organic systems. Nearly all materials of commercial import are considered.

This volume is highly recommended to those interested in the theory of solids. The electronics engineer would also do well to have this book as a reference. The book is especially valuable in that it indicates gaps in our knowledge and points the way for further research on the solid state.

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Psychology of Industrial Conflict. Ross Stagner. Wiley, New York; Chapman & Hall, London, 1956. 550 pp. Illus. $8.

Using the thesis that "wars begin in the minds of men; so do strikes and other forms of industrial conflict," Ross Stagner has attempted to construct out of the materials of psychological research a consistent theoretical framework for the analysis—and possible amelioration—of industrial conflict. Drawing upon his extensive experience and background in psychology and as a member of the Institute of Labor and Industrial Relations of the University of Illinois, he has performed an invaluable service in collating and organizing a great number of empirical studies in the field and of challenging both management and union people—those who have the motivation and background to stay with a complex treatise frequently written in technical language!—to reexamine their own insights and conclusions concerning management-union relations. But the framework itself seems to have only limited applicability to the problems at hand.

Although he does not deny the relevance or usefulness of the "macroscopic" approaches of sociology and economics, Stagner's framework is emphatically that of psychology—of individual psychology—and its principal structural members are the concepts of perception, motivation, frustration, and aggression. Although these concepts, as developed in recent research, do illuminate some small aspects of the problem, their overall inadequacy for the purpose of consistent analysis is reflected by the extent to which reference to them is absent from the treatment of major areas of concern.

The first six chapters develop the concepts of perception, motivation, and frustration and aggression, and the application of the psychological principles in these areas to management and union groups. Two succeeding chapters deal

with groups and group behavior (drawing upon group dynamics, sociometry, and industrial sociology), and the characteristics and identification of leadership. With these materials as background, the balance of the volume takes up institutions, management and union tactics, the accommodation process, the strike, cooperation, and industrial peace. A wealth of research is reported, but precisely in these areas the individual psychology principles either do not enlighten very much or seem to require undue straining of the facts. For example, in the treatment of management "tactics," it seems to stretch the point to analyze such procedures as job simplification, new machinery, time and motion study, employee testing, and so forth, as devices to afford management "ego gains," surely an incidental benefit if it occurs at all.

Although Stagner does not offer any prescriptions for its attainment, he seems to be, on the whole, optimistic about the possibilities for management-union cooperation and accommodation and industrial peace, which "is not an Utopian dream." All thinking men must agree with him that it can be achieved, however, only if the leadership is intelligent, informed, and mature. Whether these are virtues needed only or primarily by management leaders, as the author seems to imply, or perhaps by leaders on both sides of the table, and in government, is not yet clearly demonstrated. Furthermore, it sometimes seems that the leader and his perceptions may not so much shape the situation as the situation will permit a rise to leadership of the individual whose attitudes and perceptions fit the requirements of the situation.

I believe that Stagner's book is an interesting addition to the literature and worth the reader's time.

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Fire Research, 1955. H. M. Stationery Office, London, 1956 (order from British Information Services, 20 Rockefeller Plaza, New York 20). 57 pp. Illus. $0.72.

Since 1947, research on fire fighting and fire prevention in the United Kingdom has been carried on jointly by the Department of Scientific and Industrial Research and a committee formed by the insurance societies. The annual reports of the Joint Fire Research Organization provide a detailed and continuing record of the progress of this research. The most recent annual report, that for 1955, includes sections dealing with statistics of outbreaks of fires; fundamental studies of the initiation and growth of fire; results of tests on various fire-extinguishing agents; effect of fire on properties of concrete; structural aspects of fires in buildings; special fire hazards—for example, flammability of fabrics; and tests of fire-fighting equipment. A new committee to advise on research into industrial fires and explosions was set up during the year under review.

The National Academy of Sciences–National Research Council, acting on behalf of the Federal Civil Defense Administration, set up early in 1956 a Committee on Fire Research and a Fire Research Conference. Close liaison is being maintained between the British and the American organizations, and a paper on British fire research is to be read at the forthcoming Research Correlation Conference, organized by the academy.

Behavior Theory and Conditioning. Kenneth W. Spence. Yale University Press, New Haven, Conn., Geoffrey Cumberlege, Oxford University Press, London, 1956. vii + 262 pp. Illus. $4.50.

Spence represents psychology for the first time in the Silliman lectures. For this reason he begins with an essay on historical and modern conceptions of psychology. He traces psychology's struggle to become objective and defends the need for pure science research, even though it requires artificial and nonlife-like conditions of experimentation.

The remaining lectures represent a sample of psychology as science, the subject matter being that of laboratory learning and the method that of quantitative ordering of data in the context of theory. The background comes from the conditioning experiment made familiar by Pavlov and the kind of theoretical construction associated with the name of Clark L. Hull. Although Hull left his mark on a great many psychologists and other behavioral scientists who passed through Yale before his death in 1952, learning theorists look especially to Spence as the man to carry on where Hull left off. Those who were close to Hull and Spence know of their extensive correspondence about theory, and Hull in the prefaces to his major books referred to Spence's influence on his own theorizing.

In these lectures Spence has struck out on his own, acknowledging his indebtedness to Hull, but calling attention, too, to their differences. He has here brought to a head a number of suggestions that have appeared in his work during the past 20 years and has included much new analysis. The main differences in outlook between him and Hull are that Spence does not follow Hull's postulate system and the formal hypothetico-deductive method, he does not see the need for specifying a neurophysiological basis for intervening variables, and he does not commit himself on the mechanism of reinforcement.

Although in all the lectures there is a closely related interaction between data and theory, those already familiar with Hull's system will probably find Spence's treatment of motivation, especially the K factor, both the most novel and the most fertile in suggesting new lines of data gathering. The K factor refers to incentive motivation—how what happens in the goal-box affects what goes on in the next trial on the way to the goal. In rat learning, both the amount of the goal and the time spent in eating affect this subsequent behavior. According to Spence, the action is by way of motivation (K being added to D, the drive factor) rather than by way of an increase in habit strength (H), or by way of a separate process entering into multiplicative relationship with other factors. There are a number of implications systematically followed out by Spence, tested by data from his laboratory.

This is a major contribution, both to theory construction in psychology generally, and to learning theory specifically. It should help scientists from other fields to understand what psychologists are trying to do, and it should help psychologists to move forward toward the solution of their problems.

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The Chemistry of the Coordination Compounds. John C. Bailar, Jr., Ed. Reinhold, New York; Chapman & Hall, London, 1956. 834 pp. Illus. $18.50.

This is a worthy addition to the long and distinguished Monograph Series of the American Chemical Society. Although its editors disclaim an attempt to cover the entire chemistry of coordination compounds in a single volume, a remarkably broad and excellent survey of this huge subject has, nevertheless, been accomplished. When we reflect that most of the elements in the periodic table, barring only the rare gases and some of the alkali metals, are known to enter into complex compounds, the vastness of the undertaking will be appreciated.

The first of the book's 23 chapters (there are 25 contributing authors) outlines the scope of coordination chemistry according to the donor properties of some of the more important ligand atoms: halogens, oxygen, sulfur, nitrogen, phosphorus, arsenic, and carbon. Especially

welcome is the tabulation of the nomenclature rules that have been adopted by the International Union of Pure and Applied Chemistry.

In succeeding chapters the power and brilliance of Werner's theory are developed. Once so controversial, it is now accepted in all important respects. Within its framework the inorganic (or is he organic?) chemist unravels the three-dimensional complexities of molecular structure with confidence. Deservedly, many of the monograph's chapters are concerned with the details of the architecture of coordination compounds: isomerism in its many forms, chelation and heterocyclic rings, bridge structures, and coordination numbers. There is another approach than the structural one—fully as important—which takes the attention of chemists, however. It is a concern for a deeper understanding of the nature of the forces that bind atoms together. The attempts to describe these interactions on electrostatic models are well presented, and good qualitative descriptions of the atomic orbital and molecular orbital theories of binding are given. A more detailed mathematical treatment of these approximations of quantum mechanics would have been welcome.

For the most part, the emphasis has been laid on the conclusions that have been drawn from measurements, although one chapter is devoted to physical methods: spectroscopic, electrometric, magnetic, x-ray and electron diffraction, isotopic tracer, and transport studies. The over-all integration is excellent, especially in view of the numerous contributors; such overlap as does exist is commendable. The book fairly bristles with literature references, and the indexing appears to be thorough.

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Agricultural Ecology. Girolama Azzi. Constable, London, 1956 (order from Essential Books, Fair Lawn, N.J.). 424 pp. Illus. $7.20.

The relatively new science of agricultural ecology attempts to correlate the physical features of environment, soil, and climate, with the quantitative, qualitative, and generative (characters of seed) development of agricultural plants. By this approach to a study of bio-environmental relationships, the action of each factor on the plant is carefully studied, and then the effect of each is measured as a function of all the other factors. Therefore, it may be possible to obtain the same yield with quite distinct groupings of factors, because it is possible for the factors to combine in many different ways, with the most unexpected compensating effect as the result. The methods could also contribute to studies in other fields such as forestry and animal husbandry.

Part I with 12 chapters deals with the concept of meteorologic equivalents and agricultural climatology (bio-atmospheric units) in relation to the growth and yield of crop and certain woody plants. An evaluation of the atmospheric environment is attained by determining the meteorologic equivalents for each plant, which make it possible to represent and summarize climate by the frequencies of normal and abnormal situations that result from an excess or deficiency of rainfall and temperature. Consideration is also given to certain factors such as diseases and photoperiodism. Isophane charts are given for sowing and harvesting of wheat throughout the world. The equivalents are determined for each of the subperiods of vegetative development, which in the case of chestnut are (i) leafing, (ii) flowering, (iii) fruit formation, (iv) maturity, and (v) dormancy. Equivalents are given for a number of crop and woody plants. An integration of the equivalents with an evaluation of losses through excess or deficiency will yield a "climatic formula" that summarizes positive and negative atmospheric values in the various zones for each single crop.

Part II with two chapters presents the method used for determining the relationship between the positive and negative values of soils in relation to growth of various crop plants. The study of soils is characterized by (i) the determination of soil-units, (ii) the conception of the repeated series of soils, and (iii) climate-soil units or the synthesis of the physical environment. Some of the soil characteristics used in the evaluation of the effects of soil on yields are chemical capacity, water balance, and workability. The climate-soil units offer a measured representation of the physical environment that is indispensable to the agronomist, economist, and geneticist.

Part III with nine chapters is largely a discussion of the quantitative, qualitative, and generative yield of cultivated plants. Of particular interest is the system of velocity-mass-structure. Small velocity with great expansion of mass is related to productivity, while great velocity with small mass is correlated with hardiness. With rust, for example, a higher degree of resistance may even be encountered with a small velocity of development.

Part IV with four chapters deals with a general discussion on factorial combinations, geographic trials with corn, and analysis of the components of yield.

This well-organized book includes numerous tables, figures, and charts as well as a glossary and an extensive bibliography. *Agricultural Ecology* should interest all teachers and scientists in agriculture, forestry, and animal husbandry.

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New Books

The Image of the Heart. And the principle of synergy in the human mind. Daniel E. Schneider. International Universities Press, New York, 1956. 267 pp. $6.

A Space Traveler's Guide to Mars. I. M. Levitt. Holt, New York, 1956. 175 pp. $3.95.

They've Got Your Number. Robert Wernick. Norton, New York, 1956. 124 pp. $2.95.

Handbuch der Physik. Band XXI, *Gas Discharges 1.* S. Flugge, Ed. Springer, Berlin, 1956. 683 pp. DM. 105.50.

Photoconductivity Conference. Held at Atlantic City, 4–6 Nov. 1954. Sponsored by the University of Pennsylvania, Radio Corporation of America, and Office of Naval Research. R. G. Breckenridge, Chairman, Editorial Committee. Wiley, New York; Chapman & Hall, London, 1956. 653 pp. $13.50.

Topics in Number Theory. vols. 1 and 2. William J. LeVeque. Addison-Wesley, Reading, Mass., 1956. vol. 1, 198 pp., $5.50; vol. 2, 270 pp., $6.50.

Arctic Frontiers. United States explorations in the far North. John E. Caswell. University of Oklahoma Press, Norman, 1956. 232 pp. $3.75.

Fundamental Concepts of Higher Algebra. A. Adrian Albert. University of Chicago Press, Chicago, 1956. 165 pp. $6.50.

Geology of the Delaware Valley. Horace G. Richards. Mineralogical Society of Pennsylvania, Philadelphia, 1956. 106 pp. $2.50.

Education in the U.S.A. A comparative study. W. Kenneth Richmond. Philosophical Library, New York, 1956. 227 pp. $4.50.

Astronomical Optics and Related Subjects, Proceedings of a Symposium. Zdenek Kopal. North-Holland, Amsterdam; Interscience, New York, 1956. 428 pp. $12.50.

Applied Metallurgy for Engineers. Malcolm S. Burton. McGraw-Hill, New York, 1956. 407 pp. $7.50.

Challenge of the Andes. The conquest of Mount Huantsan. C. G. Egeler and T. De Booy. Translated by W. E. James. McKay, New York, 1956. 203 pp. $4.50.

Diseases of Field Crops. James G. Dickson. McGraw-Hill, New York, ed. 2, 1956. 517 pp. $8.50.

The Intellectual Life of Colonial New England. Samuel Eliot Morison. New York University Press, New York, 1956. 288 pp. $4.95.

On Freedom and Free Enterprise. Essays in honor of Ludwig von Mises. Presented on the occasion of the fiftieth anniversary of his doctorate, 20 February 1956. Mary Sennholz, Ed. Van Nostrand, Princeton, N.J., 1956. 333 pp. $3.50.

Chromium. vol. II, *Metallurgy of Chromium and Its Alloys*. American Chemical Society Monogr. Ser. Marvin J. Udy. Reinhold, New York; Chapman & Hall, London, 1956. 402 pp. $11.

J. C. Poggendorff Biographisch-Literarisches Handworterbuch der Exakten Naturwissenschaften. Band VIIa, Teil I, A–E; 2 parts (pp. 257–384 and pp. 385–547). Akademie, Berlin, 1956. DM. 16 and DM. 22.50.

The Stress of Life. Hans Selye. McGraw-Hill, New York, 1956. 324 pp. $5.95.

Rayleigh's Principles and its Applications to Engineering. The theory and practice of the energy method for the approximate determination of critical loads and speeds. G. Temple and W. G. Bickley. Dover, New York, 1956 (unabridged and unaltered republication of ed. 1). Paper, $1.50.

A Popular History of Music. Carter Harman. Dell, New York, 1956. 352 pp. Paper, $0.50.

Numerical Integration of Differential Equations. Albert A. Bennett, William E. Milne, Harry Bateman. Dover, New York, 1956 [unabridged unaltered republication of the report (Bull. 92) of the Committee of the Division of Physical Sciences of the National Research Council]. Paper, $1.35.

Lectures on the Icosahedron and the Solution of Equations of the Fifth Degree. Felix Klein. Translated by George G. Morrice. Dover, New York, ed. 2 and rev. ed., 1956. 289 pp. Paper, $1.85.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

Building Research in Canada, a Progress Report of the Division of Building Research, National Research Council. vol. 2, No. 3. National Research Council Ottawa, Canada, 1956. 30 pp. $1 for 4 issues.

How to Collect and Preserve Insects. Circ. 39. H. H. Ross. Natural History Survey Div., Urbana, Ill., 1956. 59 pp.

Laboratory Manual of Physical Chemistry. H. D. Crockford and J. W. Nowell. Wiley, New York; Chapman & Hall, London, 1956. 184 pp. $3.75.

The Dissection of the Cat (and comparisons with man). A laboratory manual of *Felis domestica*. Bruce M. Harrison. Mosby, St. Louis, ed. 3, 1956. 217 pp. $3.50.

Forest and Range Influences Publications, 1905–1955. Personnel of the Forest Service. U.S. Department of Agriculture, Washington, 1956. 78 pp.

Research Is People. A discussion of the recruitment, motivation, recognition, rating, and evaluation of research personnel. Industrial Research Institute, New York 17, 1956. 69 pp.

Variation, Relationships and Evolution in the Pachycephala Pectoralis Superspecies (Aves, Muscicapidae). Bull., Zoology, vol. 4, No. 4. Ian C. J. Galbraith. British Museum (Natural History), London, 1956. 92 pp. £1. 4s.

Progress Report on Atomic Energy Research. Hearings before the Subcommittee on Research and Development of the Joint Committee on Atomic Energy, Congress of the United States, Eighty-Fourth Congress, second session, on *Progress Report on Atomic Energy Research in Medicine, Biology, Agriculture and Food Preservation*. 4–8 June 1956. Joint Committee for Atomic Energy, Washington, 1956. 375 pp.

Scientific Research at the Natural History Museum. British Museum (Natural History), London, 1956. 46 pp. 2s. 6d.

A Laboratory Guide in Virology. Charles H. Cunningham. 145 pp. $3. *General Biology Manual*. part 1. Otto E. Kugler and John F. Glawe. 103 pp. $2.25. Burgess, Minneapolis, 1956.

Words for Work. Handbook of trade terms for a tutoring program for new Americans. S. Norman Feingold, Ed. Jewish Vocational Service, Boston, rev. ed., 1956. 140 pp. $1.

Globes and Spherical Maps. Science Bull. No. 4. Louis H. Powell. Science Museum of the St. Paul Institute, St. Paul, Minn., 1956. 16 pp.

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Aviation Cartography. A historico-bibliographic study of aeronautical charts. Walter W. Ristow. Map Div., Library of Congress, Washington 25, 1956 (order from Card Div., Library of Congress, Washington 25). 114 pp. $0.85.

Placentation of the Pigmy Treeshrew Tupaia Minor. Fieldiana: Zoology, vol. 35, No. 4. Waldemar Meister and D. Dwight Davis. 12 pp. $0.60; *A New Plethodontid Salamander from Nuevo Leon, Mexico*. vol. 39, No. 3. George B. Rabb. 10 pp. $0.20. Chicago Natural History Museum, Chicago, 1956.

Slopes of the Sea Surface Deduced from Photographs of Sun Glitter. Bull. of the Scripps Institution of Oceanography, vol. 6, No. 9. Charles Cox and Walter Munk. University of California Press, Berkeley, 1956. 88 pp. $1.75.

Parking and Buying Habits of a Store's Customers. Supplement to Spec. Rept. 11, *Parking as a Factor in Business*. Highway Research Board Spec. Rept. 11-C. 18 pp. $0.60. *Parking and Its Relationships to Business*. Summary report of project. Highway Research Board Spec. Rept. 11-D. 16 pp. $0.60. National Academy of Sciences–National Research Council, Washington 25, 1956.

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Random Functions: a Laplacian Random Function Depending on a Point of Hilbert Space. University of California Publ. in Statistics, vol. 2, No. 10. Paul Levy. University of California Press, Berkeley, 1956. 12 pp. $0.50.

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Mineral Research Development Corporation of India, Second Annual Report and Statement of Accounts. For the period ending 31 March 1956. National Research Development Corporation of India, New Delhi, 1956. 15 pp.

Atomic Energy in Canada. Includes section on the "ABC's" of atomic energy. Clyde C. Kennedy. Atomic Energy of Canada Limited, Chalk River, Ontario, 1956. 96 pp. $1.00.

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The Design and Conduct of Human Engineering Studies. Alphonse Chapanis. San Diego State College Foundation, San Diego, Calif., 1956. 73 pp. $2.

Expert Committee on Insecticides, Sixth Report. WHO Tech. Rept. Ser. No. 110. 88 pp. $0.60. *Toxic Hazards of Pesticides to Man*. WHO Tech. Rept. Ser. No. 114. 51 pp. $0.60. World Health Organization, Geneva, 1956.

Emended Description and Assignment to the New Genus Ronalea of the Idotheid Isopod Erichsonella Pseudoculata Boone. Proceedings of the U.S. National Museum, vol. 106, No. 3371. Robert J. Menzies and Thomas E. Bowman. 5 pp. *Observations on the Amphipod Genus Parhyale. Proceedings*, vol. 106, No. 3372. Clarence R. Shoemaker. 14 pp. Smithsonian Institution, Washington 25, 1956.

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The Culture and Acculturation of the Delaware Indians. Anthropological Papers, Museum of Anthropology, University of Michigan No. 10. William W. Newcomb, Jr. University of Michigan, Ann Arbor, 1956. 141 pp. $2.

Meetings and Societies

AIBS Connecticut Meetings

The 1956 annual meeting of biological societies, sponsored by the American Institute of Biological Sciences, was held at the University of Connecticut, 26–30 Aug., as part of the 75th anniversary celebrations of the university. In attendance were 3500 members of the following 23 societies: American Bryological Society, American Fern Society, American Microscopical Society, American Society for Horticultural Science, American Society of Human Genetics, American Society of Limnology and Oceanography, American Society of Naturalists, American Society of Parasitologists, American Society of Plant Taxonomists, American Society of Zoologists, Biometric Society (ENAR), Botanical Society of America, Ecological Society of America, Genetics Society of America, Mycological Society of America, National Association of Biology Teachers, Nature Conservancy, Phycological Society of America, Society for Industrial Microbiology, Society of General Physiologists, Society of Protozoologists, and Society of Systematic Zoology.

The Botanical Society of America celebrated its 50th anniversary with a golden jubilee symposium, "Progress and outstanding achievements in various fields of botany the past fifty years." At an anniversary dinner for all botanists, golden jubilee awards for meritorious achievement in the field of botany were presented to 50 outstanding botanists. A special volume of *The American Journal of Botany* will be published soon as part of the anniversary program. The Mycological Society of America celebrated its 25th anniversary with special symposia and a dinner.

As is customary, field trips preceded and followed the sessions on the Storrs campus. This year 125 members of seven societies took part in group trips in New Hampshire and Connecticut for 3 days prior to the meeting.

The general AIBS meeting for all biologists, held 27 Aug., featured a talk by Byron T. Shaw, administrator, Agricultural Research Service, USDA. Shaw discussed the tremendous advances made in agriculture through biological research and pointed to the many problems that remain to be solved in supplying the world population with adequate food, clothing, and shelter.

The AIBS also sponsored a special symposium, "Education and the future of biology," at which three speakers, John A. Behnke, Oswald Tippo, and Howard M. Phillips, told a record audience of the varied ways in which state, federal, and national organizations are attempting to meet the scientific manpower shortage, science teacher shortage, and staggering student influx. The particular attempts being made in biology were outlined, and the cooperation of all biologists was sought in some form in programs that have been initiated.

Many radiation biologists were present at Storrs, since several societies arranged symposia on some aspect of atomic radiation. The American Society for Horticultural Science's "The application of atomic energy to problems in agriculture" brought before a large audience, as one of the speakers, Rueben Pomerantz, of the U.S. Quartermaster Corps, Chicago, who told of advances in the use of radiation in food preservation. Pomerantz pointed out that since there is only a minute rise in temperature in the sterilized product during the short exposure time, the method is now referred to as "cold sterilization." Apparently the microorganisms causing food deterioration either are killed by the nuclear bombardment or are rendered incapable of reproduction. So far, cathode rays, x-rays, and gamma radiations are the only types that appear to be useful in the food industry. Some foods "sterilize" with smaller amounts of radiation than others. The process has been found suitable for meats, vegetables, fowl, fish and sea food, bakery products, and milk as well as for delaying the sprouting of tubers, destroying food-borne helminths, such as *Trichinella,* and deinfesting cereals, grains, and spices of insects. Among the current problems of the process are the subtle biochemical changes induced in the radiated foods, in some cases, in the alteration of color, odor, flavor, or texture.

A symposium on "Radiation ecology," sponsored by the Ecological Society of America, had speakers who discussed the problems of radioactive waste disposal and the ecological, food-chain hazards of fallout. Soil and ocean disposal of atomic waste from power reactors poses many problems that only concentrated, newly designed research will be able to answer. E. P. Odum, R. J. Morton, S. Auerbach, V. T. Bowen, and J. Wolfe undertook to discuss various aspects of these questions.

In the second half of the symposium, the bioaccumulation of radioisotopes received attention. Radioiodine released to the atmosphere and subsequently deposited on vegetation is concentrated to varying degrees in the thyroid glands of animals. J. J. Davis, R. F. Foster, W. C. Hanson, and R. L. Browning explained that radiophosphorus released to the Columbia River from the Hanford plant (at considerably less than dangerous levels) is transmitted through aquatic food chains to several types of waterfowl. Maximum amounts of this isotope are found in those birds which feed predominantly upon aquatic insects. Concentrations of P^{32} up to 1.5 million times that of river water have been found in egg yolk of nesting waterfowl. Environmental contaminants such as radiostrontium are doubtless more dangerous, since they have a long half-life and concentrate in bones. H. Boroughs, S. J. Townsley, and R. W. Hiatt (University of Hawaii) discussed research on the radiostrontium uptake of ocean fish. They have found that pelagic fish, such as tuna, excrete radiostrontium rapidly, but that more sluggish fish retain the element for longer periods. Radiotritium was found to be excreted even more rapidly than strontium; what remains is found in the viscera and muscles. Both isotopes are produced by bomb detonations and from nuclear power plant wastes.

R. G. Lindberg and K. H. Larson reported on the biological fate and persistence of radioactive debris from fallout. Their data, collected from the continental test sites, demonstrated that radioactive fallout contamination is decreasingly persistent in any one undisturbed environment over a period of years; that some fraction of the total radioactive contamination for any one fallout pattern is metabolized by plants and animals; that while the external radiation dose to native rodents tends to decrease with distance from Ground Zero, the chronic internal radiation dose resulting from the accumulation of radiostrontium tends to be the same or increase with distance up to 400 miles from Ground Zero. The maximum values observed were within 200 miles from Ground Zero.

The American Society of Naturalists held a symposium on "Biological chronometry," during which five scientists discussed various aspects of the presence of built-in "clocks" in animals, particularly seashore species. It appears that these internal "clocks" are set to the rhythmic patterns of the tide or of the moon. The time-keeping persists even when the animals are kept in complete darkness in the laboratory.

During sessions of the American Society of Plant Physiologists, the new group of growth substances known as gibberellins were explained by B. O. Phinney, F. H. Stodola, and S. H. Wittwer, among others. Phinney (University of California) told of a certain strain of corn, that owing to a single gene mutation, grew only to a height of 1 to 2 feet. Upon treatment with gibberellins, these plants shot up to a normal 8 feet. None of the previously known plant growth regulators, such as indoleacetic acid, had any such growth-promoting ability for these dwarfs. This is one of the first cases in higher plants of the reversal of a gene mutation by the application of a chemical substance.

Another growth phenomenon was discussed by F. C. Steward and E. M. Shantz (Cornell University). Coconut milk—and other liquid endosperms—has been found to contain substances other than the normal nutrients and vitamins needed for cell growth. When it was fed to mature plant cells, coconut milk stimulated abnormal rates of growth similar to tumorous growth. In the immature horse chestnut liquid, four active substances have been found. The presence of any of the four in a concentration as low as 1 part per million stimulates rapid growth in mature cells. None of the substances so far identified appear to be identical with any known plant hormone.

The American Society of Zoologists made a distinct contribution to the convention through a two-session symposium, "Some recent advances in invertebrate zoology," which was especially designed to bring to teachers the most up-to-date research results in zoology. A distinguished panel of speakers took part in this program: J. H. Welsh, C. L. Prosser, A. C. Hodson, T. Von Brand, W. T. Edmondson, L. H. Hyman, D. L. Nanney, P. S. Crowell, R. L. Watterson, and B. Scharrer.

In a Botanical Society of America symposium, "The beginnings of the plant world," E. S. Barghoorn (Harvard University) told of the biochemical studies of rock formations near Lake Superior that have revealed the oldest structurally preserved organisms yet discovered. Found by S. A. Tyler and investigated by Tyler and Barghoorn, the one deposit is graphitic anthracite interbedded in black shale of the Michigamme formation in the Iron River district of northern Michigan. The other is a dense black chert found in the Gunflint Iron formation on the northern shore of Lake Superior in Ontario. The organisms consist of unbranched filaments structurally resembling colonies of blue-green algae and aquatic fungi. Studies of the black chert have indicated the presence of eight amino acids and pigmented organic compounds resembling humic acids. The age of the deposits, determined by P. Hurley (Massachusetts Institute of Technology) indicate 1300 million years for the Michigan coal deposits and nearly 2000 million years for the Gunflint cherts.

E. L. Little, Jr. (U.S. Forest Service) reported on the use of helicopters for botanical field work in the tropics. This new tool not only supplies rapid transportation to inaccessible areas and makes extensive surveys possible but, because of its hoverability at low altitudes, makes the identification of vegetation or individual plant species from the air possible.

A mixture of two nitrofuran drugs (nitrofurazone and furazolidone) has been found not only to protect broilers against coccidiosis and mixed secondary infections but to increase their weight on less feed. P. D. Harwood (Hess & Clark) reported on this research and pointed out that, with 2 billion broilers raised annually in the United States, this discovery represents a considerable economic saving.

Methods of predicting wave and surf conditions were developed during World War II and utilized in landing operations in Normandy. Rhode Island has made use of these methods since 1954 to forecast conditions on the recreational ocean beaches of the state. With such advance forecasts, life guards can be distributed more advantageously, the general public can make better travel plans, and at hurricane times adequate precautions can be taken to preserve buildings, boats, and shoreline equipment. The accuracy of prediction has been within 0.6 feet 80 per cent of the time for breaker heights during normal day-to-day conditions.

S. Shapiro (Corps of Engineers Research and Development Laboratories) reported to the Society for Industrial Microbiology on a new chemical water repellent that can be added to surfaces already treated with antifungicidal agents. The combination was found to extend the life of sandbags considerably beyond that of untreated or only fungicide-treated ones. In 6 war years (1941–45, 1950–52) the Armed Forces of the U.S. bought approximately 567 million sandbags at an estimated cost of $113 million. This new process should cut considerably into this expenditure.

The presence of living algae in the air could become a public health hazard if they are allowed to accumulate radioactive wastes from contaminated areas, reported M. B. Morrow and G. H. Meyer (University of Texas). Only rarely before, have living algae been recovered, but samples have now been cultured. Clinically reported as a sensitizing agent, algae may play the role of an aeroallergen (such as pollen) as well.

Evidence was presented by A. D. Hasler, W. J. Wisby, and R. A. Parker (University of Wisconsin) to show that black bass and many other fish do not move around a lake in random fashion but have definite homing habits. Many fish species are territorial—that is, they pick a breeding site and defend it fiercely. Once the site is picked, they show an intense urge to return to it. Both the sun (and moon) and bottom landmarks seem to help in orientation to the home site, but they may not be the only guideposts. Two-thirds of all fish released experimentally away from home territory returned home. Those that did not were assumed to be bachelors or "dawdlers." The speakers stated that "statistical estimates of fish populations based on the assumption that fish are randomly dispersed must be modified to correct the formulas and design techniques for true estimates."

Orr E. Reynolds (director of the biological sciences division, Office of Naval Research) became the center of considerable attention at the Storrs meetings with a successful hand graft of embryonic cow skin. The search for suitable skin for grafting in cases of extensive, deep burns has been a subject of considerable search and research. Reynolds is one of three human "guinea pigs" on whom the grafting of cow skin has been successful. The skin must be transferred before the hair follicles form.

Neurotic tendencies among children are influenced more by environment than by heredity, according to R. B. Cattell (University of Illinois). For the first time in psychological research, the Illinois research group headed by Cattell measured the personalities of "normal" children with objective tests. Another "first" of this team was a new method of separating the hereditary traits of individuals from those due to environment. Called a "multiple-variance analysis," the method has been used only in livestock research before. Environmental influences, such as family and school, tended to raise below-average hereditary traits, while they tended to lower above-average characteristics. Cattell emphasized that this may be true only for the American culture.

F. C. Fraser (McGill University) discussed before members of the American Society of Human Genetics, the basic

problems in counseling in cases of harelip and/or cleft palate. Prediction about the risk of a subsequent child being affected is the usual problem, and, unfortunately, this cannot be given on the basis of Mendelian theory, since the familial distributions of these defects do not fit any simple genetic pattern. In experimental studies with mice, Fraser found the condition dependent, in some cases, on environmenal factors such as cortisone level and amniotic fluid pressure. He believes that there are several etiologically different types of cleft palate and that it would be most misleading to try to fit all cases into one genetic pattern.

Some reptiles traditionally labeled "cold-blooded" have warmer blood than human beings, Charles M. Bogert (American Museum of Natural History) told the biologists. Unlike birds and mammals, who waste energy converting it into internal heat, reptiles obtain their necessary body warmth directly from the sun. In doing so, they maintain body temperatures that fluctuate little more than that of human beings. Bogert said that it is doubtful that birds or mammals could have evolved from reptiles if some means of controlling body temperatures in reptiles had not arisen.

A greenhouse for every gardener may not be an idle dream. R. H. Wallace and J. S. Koths (University of Connecticut) believe that small plastic greenhouses, costing approximately $50, will be available in the near future. In their latest experiments the plastic film, oriented styrene acrylonitile, showed good weathering qualities and high transmisson of light, including ultraviolet. Necessary qualities are adequate stability against weather, including mechanical stability against temperature and moisture variations, and sufficient strength to withstand wind or hail. The "perfect" plastic should not darken or collect dirt, which will lower its light-transmission qualities. Several new plastics are being tested now under identical conditions on the Connecticut campus.

The 1957 meeting of biological societies, sponsored by AIBS, will be at Stanford University, 25 to 29 Aug.

ILEEN STEWART
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Atomic Trade Fair

The 1956 trade fair of the atomic industry provided engineers and research workers with a comprehensive display of instruments and materials for use in the nuclear sciences. Sponsored by the Atomic Industrial Forum, Inc., a nonprofit trade association composed of more than 500 companies and institutions active in some phase of atomic energy work, the fair was held at Navy Pier in Chicago, Ill., 25–27 Sept. More than 120 companies displayed their products. This figure represents a substantial increase over the number of exhibitors in last year's fair, which is evidence that industry is beginning to recognize the tremendous economic possibilities in peacetime applications of atomic energy. Significant, too, is the substantial progress the industry has made in the 2 years since Congress modified the Atomic Energy Act to allow industrial firms to join in the effort to harness nuclear reactors to the economic production of power. The attempt to build nuclear power plants represented the dominant theme in most of the exhibits.

The story was summed up by Leeds and Northrup in their simulation of a nuclear power plant. On a large display board some 20 feet across, a working model of a simulated reactor and steam-turbine generator was mounted. Directly below the display board was an actual set of instruments and recorders that would be used to control such a plant. While a moderator described the various steps involved in bringing the reactor to the critical stage, and the subsequent production of electricity from the heat generated, an operator at a control console set the various components in motion. The control rods in the reactor moved in and out, controlling the chain reaction and thus controlling the electric output. By means of a series of lights, the heat-transfer fluid could be followed from the reactor into the steam generator. The entire demonstration lasted about 12 minutes, and it served to point out the problems encountered in the design of such a plant.

Since the loosening of controls by the Government, many new firms have entered the field of producing and designing nuclear reactors. Some of these firms had already had experience in building units for the U.S. Atomic Energy Commission. The newer ones, however, have acquired their knowledge by hiring entire staffs of nuclear scientists and engineers. The models of reactors shown at the fair covered the entire range of the five basic types now proposed. Many of these have already been built and are now operating, while others have been contracted for and are presently under construction. Westinghouse displayed a model of the first industry-owned test reactor designed primarily for study of atomic fuels and materials. In addition, they also showed a mock-up of a large homogeneous reactor power plant.

Aero-Jet General Corporation displayed a model of the first mass-produced research reactor. The unit can be used for training personnel in the use of reactors as well as for research projects. Atomics International Division of North American Aviation displayed models of both power and research reactors that they are building, and some that they have already finished. Featured in the Babcock and Wilcox display was an animated model of the company's pressurized water reactor and various samples of dual elements. Swimming-pool-type reactors were shown in model form by both A.M.F. Atomics and the Foster-Wheeler Corporation.

Two companies have designed reactors specifically for medical research. Atomics International are already building one of their medical research reactors at the Medical Center of the University of California at Los Angeles. Nuclear Development Associates have developed a medical-type research reactor patterned after the requirements for such an installation presented to the Joint Congressional Committee on Atomic Energy by L. E. Farr, chairman of the medical department of Brookhaven National Laboratory.

The high energy encountered in dealing with atomic energy has prompted the search for new materials that will withstand the destructive power of intense heat and atomic radiation. Several firms have directed their efforts to this area of research. Allied Resinous Products have investigated the use of Boronol- and Resinol-polyethylene in atomic installations. These materials can be used to make sheets, rods, blocks, and other shapes. The use of beryllium as a neutron-reflecting material is also extensive in the industry. The Beryllium Corporation's exhibit was designed to demonstrate the latest advances in the shaping of beryllium. At Callery Chemical Company's display, visitors were given extensive information on sodium-potassium alloys used as heat-transfer liquids in some types of reactors.

Information on uranium and thorium, the two primary fuel elements used in reactors, was available from several firms. Michigan Chemical Company and Lindsay Chemical Company passed out information concerning their entire line of rare-earth chemicals. Mallinckrodt Chemical showed how uranium dioxide is produced from uranium hexofluoride.

The hazards associated with the handling of high-level radioactivity have resulted in the development of an entire industry devoted to the protection of nuclear scientists and engineers. Equipment of this type takes two forms, instruments to detect levels of radioactivity and devices that shield personnel.

Several companies—Jordan Electron-

ics, Chatham Electronics, Atomic Research Corporation, and Technical Associates—displayed radiation survey meters. Baird Associates, Victoreen Instrument Company, Detectolab, and Anton Electronics also displayed counters and scalers for quantitative measurement of radioactivity. In addition, Anton Electronics presented a new mobile radiological laboratory for monitoring radiation in large areas.

Probably one of the most useful pieces of equipment to the nuclear scientist is the master-slave manipulator. This instrument allows an operator to work with dangerous materials from a safe position without touching the materials under observation. In effect, it supplies him with a remote pair of hands that respond simultaneously to his own hand movements. In the past, three companies, Central Research Laboratories, General Mills, and American Machine and Foundry have been the only producers of manipulators. This year, however, General Electric displayed a new small-size manipulator for use with standard-size radioactive hoods. Although it is much smaller and simpler than its more elaborate counterparts, nevertheless, its sensitivity proved to be sufficient for a number of routine laboratory procedures. Borg-Warner Corporation introduced the newest innovation in this field with an electronically controlled manipulator. Use of this instrument permits operators to perform experiments from a distance by using closed-circuit television. The television was provided by Farnsworth Electronics Company, and visitors were allowed to try several operations.

Goodyear Atomic Corporation and Electronic Associates were both present to demonstrate the latest use of computers in solving problems in reactor design. Both firms manufacture analog-type computers. Electronic Associates also displayed an *xy* plotter that graphically traces the results of problems that are fed into the computer.

Circulatory pumps for use in atomic power plants have presented engineers with some of the most difficult problems that they have encountered, because the AEC requirements state that a pump must have zero leakage. A canned pump with a motor that is hermetically sealed off is being produced by the Byron Jackson Company. The sodium-potassium alloy of molten metal used as a heat-transfer medium in some reactors presents one of the most difficult pumping problems. The electromagnetic pump, which keeps the molten liquid metal from coming into contact with other liquids, solves this problem adequately. These pumps were displayed by the Callery Chemical Company and by Allis-Chalmers Manufacturing Company. Valves and piping also require special engineering. The Edward Valve Company and the Crane Company both showed their latest valves for atomic plumbing.

A particularly important development was introduced by the Vitro Corporation of America. Recovery of fission products and regenerated fuels has long been the aim of reactor engineers. Vitro displayed a plastic model of a recovery plant that they have contracted to build. The new plant will reprocess spent fuel from the reactor and automatically feed the fissionable material back to the reactor.

EARL J. SCHERAGO
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Programs in Mathematics, Physical Science, and Earth Science at AAAS New York Meeting

Some of the section and society programs to be presented at the 1956 AAAS meeting in New York are given here. Others will be announced in subsequent issues.

Mathematics

Section A. Vice-presidential address, "A case history in pure mathematics," by Tibor Rado, Ohio State University, 26 Dec., afternoon.

Association for Computing Machinery. Invited papers, cosponsored by Section A: "Application of digital computers"; arranged by J. P. Nash, University of Illinois. 27 Dec., morning; Joseph H. Wegstein, National Bureau of Standards, presiding. Scientific problems that will require faster machines, L. H. Thomas, Columbia University; Computers and pattern recognition, O. G. Selfridge, Massachusetts Institute of Technology; A high-school digital computer program, Aaron Buchman, Hutchinson-Central Technical High School, Buffalo, N.Y.; Election prediction by means of computers, Max A. Woodbury, New York University; Computer research and the atomic energy program, John R. Pasta, U.S. Atomic Energy Commission.

Physics

Section B, cosponsored by Sigma Pi Sigma. Symposium: "Optics and oriented nuclei"; arranged by William B. Hawkins, Yale University; 26 Dec., afternoon; Francis Bitter, Massachusetts Institute of Technology, presiding. Polarization of atoms by optical pumping, William B. Hawkins, Yale University; Effect of a buffer gas on the optical orientation process in sodium vapor, Peter Bender, National Bureau of Standards; Slow spin relaxation of sodium atoms in argon buffer, Hans Dehmelt, University of Washington; Hyperfine structure of alkali atoms in excited states, Peter Buck, Columbia University.

Symposium: "Optical absorption in solids"; arranged by William F. Meggers, National Bureau of Standards, who will preside; 26 Dec., afternoon. Absorption spectra of solids condensed at low temperatures from electric discharges, Herbert P. Broida and Arnold M. Bass, National Bureau of Standards; Lattice vibration absorption spectra of polar and homopolar crystals, Elias Burstein, Naval Research Laboratory; Line spectra and magnetic properties of solids, G. H. Dieke, Johns Hopkins University; Infrared absorption spectra of solid solutions, Henry W. Morgan, Oak Ridge National Laboratory.

Vice-presidential address, "Science in society today," by Alan T. Waterman, National Science Foundation; 26 Dec., afternoon.

Two-session symposium: "Diffusion in solids"; arranged by H. B. Huntington, Rensselaer Polytechnic Institute, who will preside; 27 and 28 Dec., morning. Part I: Diffusion in solids: a survey, David Lazarus, University of Illinois; Mobility and diffusion, Lawrence S. Darken, U.S. Steel Corporation; Effect of pressure on diffusion, Norman Nachtrieb, University of Chicago; Grain boundary diffusion and its role in solid-state reactions, David Turnbull, General Electric Company. Part II: Modern techniques in diffusion research, Frank E. Jaumot, Franklin Institute; Diffusion in ionic crystals, Howard W. Etzel, Naval Research Laboratory; Diffusion in semiconductors, F. J. Morin, Bell Telephone Laboratories; Indirect measurements of atomic movements, Arthur Nowick, Yale University.

Two-session symposium: "Crystal growth"; arranged by Nicolas Cabrera, University of Virginia; 29 Dec., morning and afternoon. Part I, "Growth from the melt"; David Turnbull, General Electric Laboratory, presiding. Crystal growth from the melt, Bruce Chalmers, Harvard University; Growth of single crystals of Ge and Si, William G. Pfann, Bell Telephone Laboratories; Decoration of dislocations in Si by precipitated Cu, W. C. Dash, General Electric Laboratory; Growth forms and preferred orientations, W. A. Tiller, Westinghouse Research Laboratories; Melting and freezing of p-toluidine, G. W. Sears, General Electric Laboratory. Part II, "Growth of whiskers"; H. C. Herring, Bell Telephone Laboratories, presiding. Theory of crystal growth, Nicolas Cabrera; Formation of whiskers, G. W. Sears; Properties of

whiskers, S. S. Brenner, General Electric Laboratory; Growth and structure of spontaneous whiskers, R. G. Treuting and S. N. Arnold, Bell Telephone Laboratories; Growth of whiskers from the vapor, R. V. Coleman, University of Virginia; Tensile and torsion tests on whiskers, R. L. Eisner, Westinghouse Research Laboratories.

Chemistry (in Part)

Section C. Symposium: "Organic reaction mechanisms"; arranged by Ellis V. Brown, Seton Hall University, who will preside. 29 Dec., morning. Studies in biphenyl stereochemistry, Kurt Mislow, New York University; Oxidation behavior of 1,1 and 1,2-disubstituted cyclic hydrazines; new reactions of N-amino and N-nitroso compounds, Charles Overberger, Polytechnic Institute of Brooklyn; Stereospecific polymerizations, Charles Price, University of Pennsylvania; Alkylation and acylation of enamines derived from ketones and aldehydes, Gilbert Stork, Columbia University; Some consequences of the reversibility of radical addition reactions; Cheves Walling, Columbia University.

Alpha Chi Sigma. Dinner and meeting of New York professional chapter; 28 Dec., evening. "The chemist and management," Clifford F. Rassweiler, Johns-Manville Corporation.

Gordon Research Conferences. Dinner and address, "The future through science," by Glenn T. Seaborg, University of California, in celebration of the 25th anniversary of the Gordon Research Conferences. Emil Ott, Food Machinery and Chemical Corporation, presiding; 27 Dec., evening.

Astronomy

Section D. Vice-presidential address, "The solar cycle," by Seth B. Nicholson, Mount Wilson Observatory; 27 Dec., evening.

American Astronomical Society, cosponsored by Section D. Welcome, demonstration, open house, and reception; 26 Dec., evening. Helen B. Warner lecture, by Harold L. Johnson, Lowell Observatory; 27 Dec., afternoon. Contributed papers; 27–29 Dec., mornings and afternoons. Symposium: "The recent close approach of Mars"; arranged by J. Allen Hynek, Harvard College Observatory; 28 Dec., afternoon; Fred Whipple, Smithsonian Astrophysical Observatory, presiding. R. S. Richardson, Mount Wilson Observatory; John Shaw, Perkins Observatory; C. H. Mayer, Naval Research Laboratory; C. C. Kiess, National Bureau of Standards; Seymour Hess, Florida State University.

Astronomical League. Round-table panel discussion: "The benefits of astronomy to young people"; arranged by Harold B. Davidson, New York, 15 papers and exhibits; 28 Dec., morning.

Geology and Geography

Section E, cosponsored by the Geological Society of America. Contributed papers: general geology; 26 Dec., morning.

Three-session symposium, cosponsored by the American Geophysical Union: "Recent advances in geochronometry"; arranged by J. Laurence Kulp, Lamont Geological Observatory, Columbia University. Part I, "Potassium-argon and rubidium-strontium methods"; 26 Dec., afternoon; J. Laurence Kulp, presiding. The potassium-argon age method, George W. Wetherill, Carnegie Institution; New potassium-argon dates on plutonic rocks, Leon E. Long, Lamont Geological Observatory; Potassium-argon dating of sediments, Joseph Lipson, University of California; The rubidium-strontium age method and the age of ancient granitic rocks, Paul W. Gast, Lamont Geological Observatory; Rubidium-strontium ages of glauconite, Randall F. Cormier, Massachusetts Institute of Technology. Part II, "Uranium, thorium, and lead methods and the age of meteorites"; 27 Dec., morning; George W. Wetherill, Carnegie Institution, presiding. Uranium and thorium dating, George R. Tilton, Carnegie Institution; The problem of old radiogenic lead in U-Pb dating, Lorin R. Stieff, U.S. Geological Survey; Methods of estimating the age of common lead minerals, Ron M. Farquhar, University of Toronto; Dating by the lead-alpha method, David Gottfried, U.S. Geological Survey; The age of meteorites, Claire C. Patterson, California Institute of Technology. Part III, "Radiocarbon dating," cosponsored by Sections F, G, and H; 28 Dec., morning; J. Laurence Kulp, presiding. Current techniques and problems in radiocarbon dating, Wallace S. Broecker, Lamont Geological Observatory; Radiocarbon dates and Pleistocene chronology, Richard F. Flint, Yale University; Radiocarbon dates and archeology, Hallam L. Movius, Jr., Harvard University; Other isotopic chronometers for the Pleistocene and Recent, James R. Arnold, Princeton University; Panel and general discussion.

Symposium: "Carbonate sedimentation"; arranged by Rhodes W. Fairbridge, Columbia University, who will preside; 26 Dec., evening. Clastic limestone calcarenites and precipitated calcarenites, Frank W. Beales, University of Toronto; Eolian calcarenites as paleoclimatic indicators, Rhodes W. Fairbridge; Dolomite in the Florena Shale of Kansas, John Imbrie, Columbia University; Studies of Bahamian limestone seas, Norman D. Newell and John Imbrie, Columbia University; Petrography of some Pacific atoll dolomites, Seymour O. Schlanger, U.S. Geological Survey; The significance of trace elements in carbonate sediments, Karl K. Turekian, Yale University; Carbonate replacement of quartz and feldspar as a source of silica in silicified sediments, Theodore R. Walker, University of Colorado; Tonal dilation in carbonate photography, R. J. Dunham, Shell Development Company.

Two-session symposium: "Ground water"; arranged by A. Nelson Sayre, U.S. Geological Survey. Part I, 29 Dec., morning; A. N. Sayre and Henry C. Barksdale, U.S. Geological Survey, presiding. Application of geology to the investigation of water resources, A. N. Sayre; Relationship between the water table and zone of aeration, Irwin Remson, J. R. Randolph and H. C. Barksdale, U.S. Geological Survey; Quantitative approach used on ground-water investigations, John G. Ferris and A. Nelson Sayre, U.S. Geological Survey; Mining hydrology, Wilbur T. Stuart, U.S. Geological Survey; Relationship between fresh and salty ground water in southern Nassau and southeastern Queens Counties, Long Island, New York, N. M. Perlmutter, J. L. Geraghty and J. E. Upson, U.S. Geological Survey; Concepts and principles of salt water encroachment, N. J. Lusczynski, U.S. Geological Survey. Part II, 29 Dec., afternoon; R. M. Leggette, Leggette, Brashears and Graham, New York, and J. E. Upson, U.S. Geological Survey, presiding. Ground-water problems in New York and New England, J. E. Upson; Ground water in north-central Connecticut, R. V. Cushman, U.S. Geological Survey; Utilization of ground water in Suffolk County, New York, J. F. Hoffman, U.S. Geological Survey; Some aspects of the interrelation between ground water and engineering structures, Sidney Paige, Columbia University; Ground-water provinces in India, George C. Taylor, Jr., U.S. Geological Survey.

Vice-presidential address, "The training of a geologist," by Carl Tolman, Washington University, and Smoker; 29 Dec., evening.

Two-session symposium: "Appalachian stratigraphy and structure"; arranged by John Rodgers, Yale University, who will preside; 30 Dec., morning and afternoon. Part I: Formational units in the Knox dolomite, C. R. L. Oder, American Zinc Company of Tennessee; Structural geology of the area between the Copper Creek and Saltville faults, Grainger, Hancock, and Hawkins Counties, Tennessee, John B. Sanders, Yale University; Iron Mountain thrust fault at Watauga Dam, Tennessee, Leland F. Grant and John M. Kellberg, Tennessee Valley Authority; The Stones River group of

Pennsylvania, C. E. Prouty, University of Pittsburgh; Boulder-filled dikes near Burlington, Vermont, David Hawley, Hamilton College; Devonian section at Bowmanstown, Pennsylvania, Bradford Willard, Lehigh University; Stratigraphy and structure of the Stissing Mountain area, New York, Eleanora B. Knopf, Stanford University; Structural elements of the northeastern Appalachian basin, Herbert P. Woodward, Rutgers University. Part II: Stratigraphic relationships in northern Vermont and southern Quebec, Wallace M. Cady, U.S. Geological Survey; Stratigraphy and structure of the Sutton Mountains, Quebec, P. H. Osberg, Colby College; Stratigraphy and structure of the north end of the Taconic Range, E-an Zen, Harvard University; The Skitchewaug Nappe, a major recumbent fold in the area about Claremont, New Hampshire, James B. Thompson, Jr., Harvard University; The metamorphic geology of the Middle Haddam area, Connecticut, John L. Rosenfeld and Gordon P. Eaton, Wesleyan University; Lead-alpha ages of Rhode Island granitic rocks compared with their geologic ages, Alonzo W. Quinn, Brown University, Howard W. Jaffe, W. L. Smith and C. L. Waring, U.S. Geological Survey; Stratigraphy of the pre-Silurian sedimentary rocks in Maine, Robert B. Neuman, U.S. Geological Survey; The geology of the Danbury and Bethel quadrangles, Connecticut, James W. Clarke, University of South Carolina; A third class of arcuate structures, B. Ashton Keith, Institute of Sciences, Washington, D.C.

Association of American Geographers, cosponsored by Section E. Invited papers: "Geographic research in progress"; arranged by John E. Brush, Rutgers University, and David H. Miller, Quartermaster Research and Development Center, Natick, Mass. Part I, 27 Dec., morning; William L. Thomas, Jr., Wenner-Gren Foundation, presiding. Sunlight in coniferous forest, David H. Miller; Relief, slope, and natural vegetation in the United States, Walter Wood, Quartermaster Research and Development Center; Geographic representation of rural settlement: a method of generalizing dispersed rural dwellings, businesses, and farmsteads, Arthur F. Loeben, University of Pennsylvania; Research approaches to the megalopolis of the northeastern seaboard: Boston to Washington, D.C., Jean Gottmann, Twentieth Century Fund. Part II, 28 Dec., morning; Peter M. Stern, Conservation Foundation, presiding. Topoclimatic investigations in the Brooks Range, Alaska, Robert Anstey, Quartermaster Research and Development Center; Microclimatic investigation at Point Barrow, Alaska, Stanton J. Ware, Drexel Institute Laboratory of Climatology; Glacier and related botanical studies in the Pacific Northwest, Calvin J. Heusser, American Geographical Society of New York; Some aspects of the climatology of glaze in the United States, Iven Bennett, Quartermaster Research and Development Center.

National Speleological Society. General session; 29 Dec., afternoon.

Meeting Notes

■ The fifth annual meeting of the American Society of Tropical Medicine and Hygiene was held in New Orleans, 31 Oct.–3 Nov. Ninety papers were presented. Included among these were ten dealing with a symposium on "Helminthic infections as the cause of disability and disease," which was moderated by Norman R. Stoll of the Rockefeller Institute for Medical Research, New York. The 21st annual Charles Franklin Craig lecture on "The role of pharmacology in determining the rational use of therapeutic agents" was delivered by Leon H. Schmidt of Cincinnati, Ohio. For "meritorius achievement in tropical medicine," Karl F. Meyer of the Hooper Foundation, San Francisco, Calif., was presented with the Walter Reed medal. Asa C. Chandler of the Rice Institute presented as his presidential address "The interrelations of nutrition and infectious diseases in the tropics."

The following officers were elected: pres.-elect, Donald L. Augustine, Department of Tropical Public Health, Harvard School of Public Health; v. pres., G. Robert Coatney, Laboratory of Tropical Diseases, National Institutes of Health; and sec.-treas., Rolla B. Hill, 3575 St. Gaudens Rd., Miami 33, Fla.

■ The Instrument Society of America has announced the establishment of the nonprofit Foundation for Instrumentation Education and Research. The objective of the foundation is to stimulate, guide, and support programs of education and fundamental research in the field of instrumentation. A year ago, at the society's national meeting in Los Angeles, Calif., a commission was appointed to formulate plans and create a foundation in accordance with the evolving needs of industry and Government.

The commission's report, which was recently accepted by the ISA, provides for the establishment of a nonprofit foundation to be financed through funds made available to it from individuals, trade associations, societies, and industrial contributors. The foundation is to function as a separate corporation under the direction of a board of trustees made up of representatives of industry, government, and education. The president and president-elect of ISA will serve as trustees, ex-officio. The functions of the board of trustees include (i) evaluation of current instrumentation educational programs; (ii) planning and directing fund-raising projects; and (iii) administering the affairs of the foundation.

The ISA has made an initial grant of $40,000 to the foundation, earmarked for specific objectives and services deemed "essential to the national economy" by the ISA. Grants to the foundation may be restricted to specific uses or may be for general support of the foundation's objectives. Initially, the ISA will provide office space and administrative and staff services to the foundation; William H. Kushnick, executive director of ISA, will serve as executive director of the foundation.

■ A conference on the theory of analytic functions (of one or more complex variables) will be held at the Institute for Advanced Study at Princeton, N. J., from 1 Sept. to 14 Sept. 1957. There will be lectures and seminars and a small number of hour-long addresses. In addition several special seminars will be conducted each day at different hours in the following fields: (i) "Theory of functions of several complex variables"; (ii) "Conformal mapping and Schlicht functions"; (iii) "Riemann surfaces"; (iv) "Theory of automorphic functions"; and "Analytic functions as related to Banach algebras."

Membership in the conference is by invitation. About 60 mathematicians have been invited, including about 25 from foreign countries. The meeting is supported by the Air Force Office of Scientific Research under a contract with the Institute for Advanced Study. The committee in charge of the conference is composed of Marston Mores (chairman) Arne Beurling, and Atle Selberg.

The papers presented at the seminars will be reproduced and will become available for limited distribution. The principal addresses will appear in book form in the Princeton Series and will be on sale at the Princeton University Press, Princeton, N.J. The secretary of the conference is Mrs. Joan Slotnick, Fuld Hall, Institute for Advanced Study, Princeton, N.J.

■ A symposium on host-specificity and parallel evolution among parasitic insects and worms will take place at Neuchâtel, Switzerland, 15–18 Apr. 1957, under the chairmanship of Ernst Mayr of Harvard University. The aim is to bring together both parasitologists and specialists of the vertebrate host groups to discuss the various problems, which have been tentatively grouped under the following headings: adaptation, dispersal, speciation, and phylogeny.

The following specialists have agreed to present reports or to take part in the

discussions: *Hosts.* Harrison-Mathews (London), Kuhn-Schneider (Zürich), Marshall (London), B. Patterson (Harvard), Stresemann (Berlin). *Parasites.* Baer (Neuchâtel), Chabaud (Paris), Clay (London), Dubois (Neuchâtel), Euzet (Montpellier), Hopkins (Tring), Kent (Baltimore), Llewellyn (Birmingham), Manter (Lincoln, Neb.), Theodor (Jerusalem). It is planned to have all the reports available at the meeting in either mimeographed or printed form so that translations will not be necessary and more time will be left for discussions.

This symposium is being held under the auspices of the International Union of Biological Sciences and the University of Neuchâtel. Further particulars may be obtained from the General Secretary, Dr. Jean G. Baer, C.P.2 Neuchâtel 7, Switzerland.

Society Elections

■ Wilderness Society: honorary pres., Benton MacKaye; honorary v. pres., Irving M. Clark and Charles G. Woodbury; pres., Olaus J. Murie; v. pres., Harvey Broome; treas., Harold C. Anderson.

■ American Medical Writers' Association: pres., Dean F. Smiley, *Journal of Medical Education*; pres.-elect, Charles E. Lyght, Merck and Company, Inc.; past pres., Richard M. Hewitt, Mayo Clinic; 1st v. pres., Morris Fishbein, *Excerpta Medica*; 2nd v. pres., Theodore R. Van Dellen, *Chicago Tribune*; sec.-treas., Harold Swanberg, *Mississippi Valley Medical Journal*, Quincy, Ill. Representative to the AAAS Council is Harold Swanberg.

■ Mycological Society: pres., D. P. Rogers, New York Botanical Gardens; pres.-elect, J. R. Raper, Harvard University; v. pres., Constantine J. Alexopoulos, University of Iowa; sec.-treas., E. S. Beneke, Michigan State University. Representative to the AAAS Council is George W. Fischer.

■ Phi Sigma Society: pres., Karl F. Lagler, University of Michigan; v. pres., Henry van der Schalle, University of Michigan; exec. sec.-treas., Fred S. Orcutt, Viriginia Polytechnic Institute; honorary pres., Laurence H. Snyder, University of Oklahoma; past pres., A. I. Ortenburger, University of Oklahoma.

Forthcoming Events

December

19. Arctic Branch, Alaska Div., AAAS, College Alaska. (Miss C. Juedes, Box 47, College.)

26–31. American Assoc. for the Advancement of Science, annual, New York, N.Y. (R. L. Taylor, AAAS, 1515 Massachusetts Ave., NW, Washington 5.)

The following 56 meetings are being held in conjunction with the AAAS annual meeting.

AAAS Academy Conference (L. Taylor, West Virginia Univ., Morgantown). 29–30 Dec.

AAAS Cooperative Committee on the Teaching of Science and Mathematics (M. Meister, Bronx High School of Science, New York 68). 27 Dec.

AAAS-Gordon Research Conferences (W. G. Parks, Univ. of Rhode Island, Kingston). 27 Dec.

Alpha Chi Sigma (H. G. Seavey, 30 Church St., Room 340, New York 7). 28 Dec.

Alpha Epsilon Delta (M. L. Moore, 7 Brookside Circle, Bronxville, N.Y.). 29 Dec.

American Assoc. of Clinical Chemists (A. E. Sobel, Jewish Hospital of Brooklyn, Brooklyn 16, N.Y.).

American Assoc. of Hospital Consultants (E. D. Barnett, School of Public Health, Columbia Univ., New York 32.)

American Assoc. of Scientific Workers (R. J. Rutman, 6331 Ross St., Philadelphia 44, Pa.). 29 Dec.

American Astronomical Soc. (J. A.

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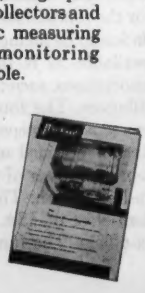

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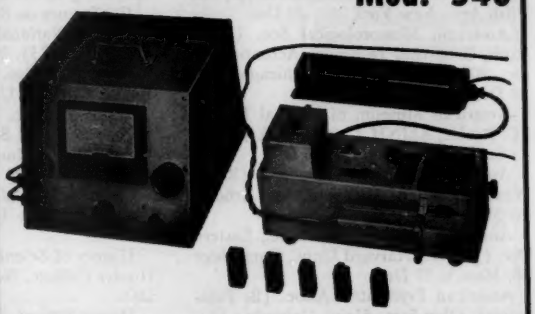

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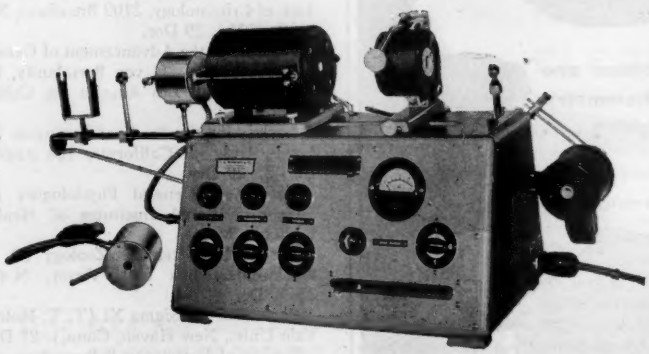

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Hynek, Harvard College Observatory, Cambridge 38, Mass.). 26–29 Dec.

American Documentation Inst. (J. Hilsenrath, National Bureau of Standards, Washington 25). 27–29 Dec.

American Educational Research Assoc. (A. G. Wesman, Psychological Corp., 522 Fifth Ave., New York 36). 29 Dec.

American Meteorological Soc. (R. J. Roth, Crop-Hail Insurance Actuarial Assoc., 209 W. Jackson Blvd., Chicago, Ill.). 28 Dec.

American Museum of Natural History (G. Reekie, AMNH, Central Park West at 79 St., New York, N.Y.). 26 Dec.

American Nature Study Soc. (R. L. Weaver, Univ. of Michigan, Ann Arbor). 26–30 Dec.

American Philosophical Assoc., Eastern Div. (J. Wild, Harvard Univ., Cambridge 38, Mass.). 27 Dec.

American Psychiatric Assoc. (B. Pasamanick, Ohio State Univ., Columbus 10). 28–29 Dec.

American Soc. of Hospital Pharmacists (G. E. Archambault, U.S. Public Health Service, Washington 25). 29 Dec.

American Soc. of Range Management (F. G. Renner, Soil Conservation Service, U.S. Dept. of Agriculture, Washington 25). 28 Dec.

American Statistical Assoc. (R. E. Johnson, Western Electric Co., New York 7).

Association for Computing Machinery (J. P. Nash, Univ. of Illinois, Urbana).

Association of American Geographers (P. M. Stern, Conservation Foundation, 30 E. 40 St., New York, N.Y.).

Astronomical League (H. B. Davidson, 812 Park Ave., New York 21.)

Conference on Scientific Editorial Problems (J. G. Adashko, Ford Instrument Co., Long Island City, N.Y.). 26–28 Dec.

Conference on Scientific Manpower (T. J. Mills, National Science Foundation, Washington 25). 26 Dec.

Ecological Soc. of America (M. F. Buell, Rutgers Univ., New Brunswick, N.J.). 26–30 Dec.

Entomological Soc. of America (P. W. Oman, Plant Industry Sta., Beltsville, Md.). 27–30 Dec.

Genetics Soc. of America (A. W. Pollister, Columbia Univ., New York 27). 28 Dec.

History of Science Soc. (Miss P. Kibre, Hunter College, New York, N.Y.). 27–29 Dec.

Honor Soc. of Phi Kappa Phi (L. R. Guild, 634 So. Western Ave., Los Angeles 5, Calif.). 28–29 Dec.

Institute of Mathematical Statistics (Miss E. Scott, Univ. of California, Berkeley 4).

International Council for Exceptional Children (M. H. Fouracre, Columbia Univ., New York 27). 26 Dec.

International Union for the Study of Social Insects, North American Section (T. C. Schneirla, American Museum of Natural History, Central Park West at 79 St., New York, N.Y.). 26–27 Dec.

Mountain Lake Biological Sta. (B. D. Reynolds, Univ. of Virginia, Charlottesville).

Mycological Soc. of America (L. S. Olive, Columbia Univ., New York 27). 26 Dec.

National Acad. of Economics and Political Science (D. P. Ray, George Washington Univ., Washington, D.C.). 27 Dec.

National Assoc. for Gifted Children (Miss A. F. Isaacs, 409 Clinton Springs Ave., Cincinnati, Ohio).

National Assoc. for Research in Science Teaching (N. Washton, Queens College, Flushing 67, L.I., N.Y.). 27 Dec.

National Assoc. of Biology Teachers (J. Breukelman, State Teachers College, Emporia, Kan.). 26–30 Dec.

National Assoc. of Science Writers (J. E. Pfeiffer, New Hope, Pa.).

National Geographic Soc. (W. R. Gray, NGS, 16 and M Sts., NW, Washington 6). 29 Dec.

National Speleological Soc. (Brother G. Nicholas, LaSalle High School, Cumberland, Md.). 29 Dec.

New York Acad. of Sciences (R. F. Nigrelli, New York Zoological Soc. and M. Kopac, New York Univ., Washington Sq., New York, N.Y.). 29 Dec.

Philosophy of Science Assoc. (C. W. Churchman, Case Inst. of Technology, Cleveland, Ohio). 29–30 Dec.

Pi Gamma Mu (B. H. Williams, Industrial College of the Armed Forces, Washington 25). 26 Dec.

Scientific Research Soc. of America (D. B. Prentice, Yale Univ., New Haven, Conn.). 26–27 Dec.

Sigma Delta Epsilon (C. Chandler, Boyce Thompson Inst. for Plant Research, 1086 N. Broadway, Yonkers 3, N.Y.).

Sigma Pi Sigma (M. W. White, Pennsylvania State Univ., University Park).

Society for the Advancement of Criminology (D. E. J. MacNamara, New York Inst. of Criminology, 2109 Broadway, New York, N.Y.). 29 Dec.

Society for the Advancement of General Systems Theory (L. von Bertalanffy, Mt. Sinai Hospital, Los Angeles 48, Calif.). 29–30 Dec.

Society for the Study of Evolution (H. Lewis, Univ. of California, Los Angeles 24). 27–29 Dec.

Society of General Physiologists (A. Shanes, National Institutes of Health, Bethesda, Md.).

Society of Systematic Zoology (R. E. Blackwelder, Box 500, Victor, N.Y.). 27–30 Dec.

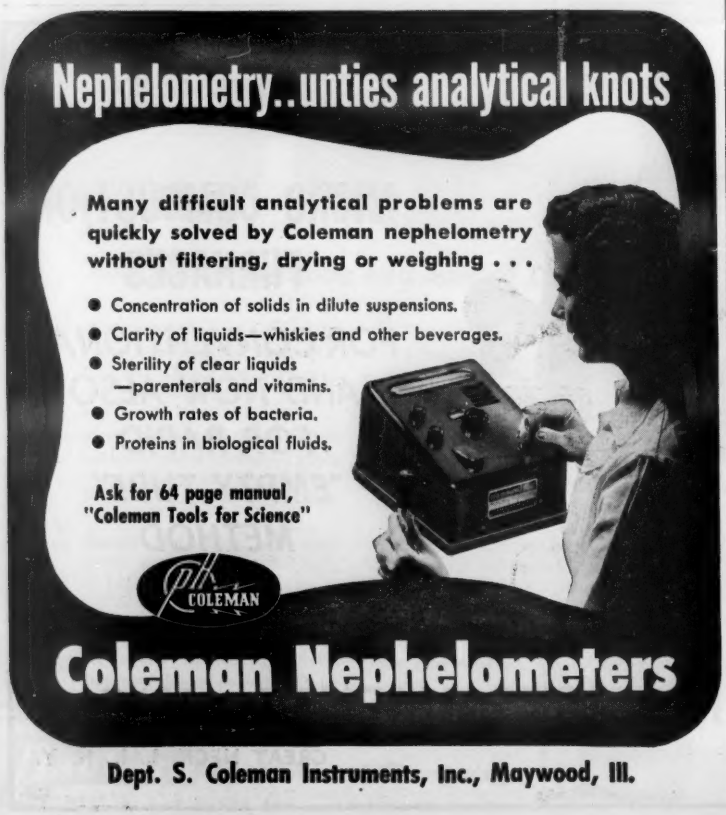
Society of the Sigma Xi (T. T. Holme, Yale Univ., New Haven, Conn.). 27 Dec.

Society of Vertebrate Paleontology, annual (J. T. Gregory, Peabody Museum of Natural History, Yale Univ., New Haven, Conn.). 28–30 Dec.

Torrey Botanical Club (David Keck, New York Botanical Garden, Bronx Park, New York 58). 26–27 Dec.

United Chapters of Phi Beta Kappa (C. Billman, PBK, 1811 Q St., NW, Washington 6). 27 Dec.

27–28. Fluid Mechanics in Chemical Engineering, American Chemical Soc., Lafayette, Ind. (W. E. Ranz, Dept. of Engineering Research, Pennsylvania State Univ., University Park.)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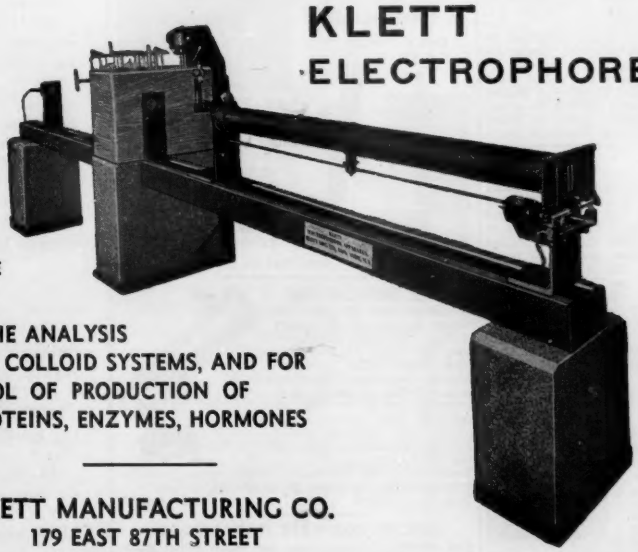

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27–28. Linguistic Soc. of America, Philadelphia, Pa. (A. A. Hill, Box 7790, University Sta., Austin 12, Tex.)

27–29. American Mathematical Soc., 63rd annual, Rochester, N.Y. (J. H. Curtiss, AMS, 80 Waterman St., Providence 6, R.I.)

27–29. American Physical Soc., Monterey, Calif. (W. A. Nierenberg, Univ. of California, Berkeley 4.)

27–29. Western Soc. of Naturalists, annual, Goleta, Calif. (D. Davenport, Santa Barbara College, Goleta.)

27–30. American Economic Assoc., annual, Cleveland, Ohio. (J. W. Bell, 629 Noyes St., Evanston, Ill.)

27–30. American Finance Assoc., annual, Cleveland, Ohio. (G. E. Hassett, Jr., New York Univ., 90 Trinity Place, New York 6.)

28. Society for the Advancement of Criminology, annual western, Fresno, Calif. (W. Dienstein, Fresno State College, Fresno.)

28–29. American Folk-Lore Soc., annual, Santa Monica, Calif. (MacE. Leach, Bennett Hall, Univ. of Pennsylvania, Philadelphia 4.)

28–30. American Anthropological Assoc., annual, Santa Monica, Calif. (W. S. Godfrey, Jr., Logan Museum, Beloit College, Beloit, Wis.)

28–30. American Historical Assoc., annual, St. Louis, Mo. (AHA, Study Room 274, Library of Congress, Washington 25.)

28–30. Archaeological Inst. of America, annual, Philadelphia, Pa. (C. Boulter, Library, Univ. of Cincinnati, Cincinnati 21, Ohio.)

28–30. Industrial Relations Research Assoc., Cleveland, Ohio. (E. Young, Sterling Hall, Univ. of Wisconsin, Madison 6.)

29. Mathematical Assoc. of America, 40th annual, Rochester, N.Y. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

29–30. American Chemical Soc., Div. of Industrial and Engineering Chemistry, Princeton, N.J. (A. H. Emery, ACS, 1155 16 St., NW, Washington 6, D.C.)

January

7–11. International Social Science Council, 3rd gen'l. assembly, Paris, France. (Secretary Gen'l., ISSC, 19, avenue Kleber, Paris 16.)

10. Technical and Clinical Applications of Radioisotopes, Assoc. of Vitamin Chemists, Chicago, Ill. (M. Freed, Dawe's Laboratories, Inc., 4800 S. Richmond St., Chicago 32.)

10–12. American Group Psychotherapy Assoc., 14th annual, New York, N.Y. (C. Beukenkamp, Jr., AGPA, Room 300, 345 E. 46 St., New York 17.)

14–16. Cottonseed Processing as Related to the Nutritive Value of the Meal, 4th conf., New Orleans, La. (Southern Regional Research Lab., USDA, 1100 Robert E. Lee Blvd., New Orleans 19.)

14–16. Reliability and Quality Control in Electronics, 3rd natl. symp., Washington, D.C. (C. M. Ryerson, Radio Corp. of America, Bldg. 10–6, Camden 2, N.J.)

14–18. Society of Automotive Engineers, annual, Detroit, Mich. (Meetings Div., SAE, 29 W. 39 St., New York 18.)

14–20. Indian Science Cong. Assoc., 44th meeting, Calcutta, India. (General Secretary, ISCA, 1 Park St., Calcutta 16.)

15. Society for Applied Spectroscopy, Philadelphia, Pa. (F. M. Biffen, Johns-Manville Research Center, Manville, N.J.)

16–23. Australian and New Zealand Assoc. for the Advancement of Science, 32nd meeting, Dunedin, N.Z. (J. R. A. McMillan, ANZAAS, Science House, 157 Gloucester St., Sydney, N.S.W., Australia.)

17–18. Engineers Joint Council, New York, N.Y. (EJC, 29 W. 39 St., New York 18.)

18–19. Symposium on Blood, 6th annual, Detroit, Mich. (W. H. Seegers, Wayne State Univ. Coll. of Medicine, Detroit 7.)

21–22. Solar Furnace Design and Operation, Phoenix, Ariz. (J. I. Yellott, Assoc. for Applied Solar Energy, 3424 N. Central Ave., Phoenix.)

21–25. American Inst. of Electrical Engineers, winter general, New York, N.Y. (N. S. Hibshman, AIEE, 39 W. 39 St., New York 18.)

23–25. Very Low Frequency Electromagnetic Waves, symp., Boulder, Colo. (J. R. Wait, National Bureau of Standards, Boulder.)

28–29. Many Body Problem, symp., Hoboken, N.J. (G. J. Yevick, Dept. of Physics, Stevens Inst. of Technology, Hoboken.)

28–31. American Meteorological Soc., New York, N.Y. (K. C. Spengler, AMS, 3 Joy St., Boston 8, Mass.)

28–31. Modern Methods of Analytical Chemistry, 10th annual symp., Baton Rouge, La. (P. W. West, Louisiana State University, Baton Rouge.)

30–1. American Assoc. of Physics Teachers, New York, N.Y. (F. Verbrugge, Carleton College, Northfield, Minn.)

30–31. College-Industry Conf., 9th annual, American Soc. for Engineering Education, Los Angeles, Calif. (Univ. of California Extension, Engineering, Los Angeles 24.)

31–2. Western Soc. for Clinical Research, 10th annual, Carmel-by-the-Sea, Calif. (A. J. Seaman, WSCR, Univ. of Oregon Medical School, Portland 1.)

February

4–8. American Soc. for Testing Materials, Philadelphia, Pa. (R. J. Painter, ASTM, 1916 Race St., Philadelphia 3.)

10–12. Canadian Ceramic Soc., 55th annual, Niagara Falls, Ont., Canada. (L. C. Keith, 49 Turner Road, Toronto, Ont.)

14. Present Status of Heart Sound Production and Recording, symp., Buffalo, N.Y. (R. M. Kohn, Univ. of Buffalo, 2183 Main Street, Buffalo 14, N.Y.)

14. Significance of Nucleic Acid Derivatives in Nutrition, Assoc. of Vitamin Chemists, Chicago, Ill. (M. Freed, Dawe's Laboratories, Inc., 4800 S. Richmond St., Chicago 32.)

(See issue of 16 November for comprehensive list)

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■ POCKET *p*H METER, which has heretofore been available only as a complete unit together with probes and batteries, is now available as a separate item. (Analytical Measurements, Inc., Dept. S69)

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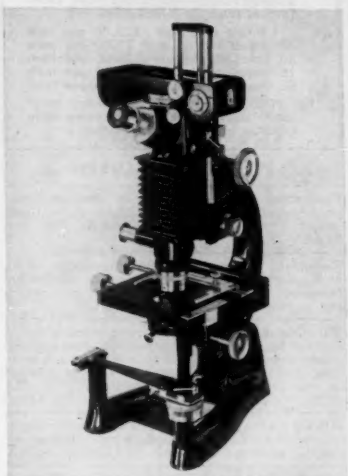

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4. Programs of the 18 AAAS sections (symposia and contributed papers).
5. Programs of the more than 80 participating societies.
6. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Manpower, National Geographic Society, Phi Beta Kappa, RESA, Sigma Xi.
7. Details of the Hotel Statler—center of the Meeting—and other hotels and session sites.
8. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
9. Exhibitors in the 1956 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1956.
2. Complete roll of AAAS presidents and their fields.
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5. Publications of the Association.
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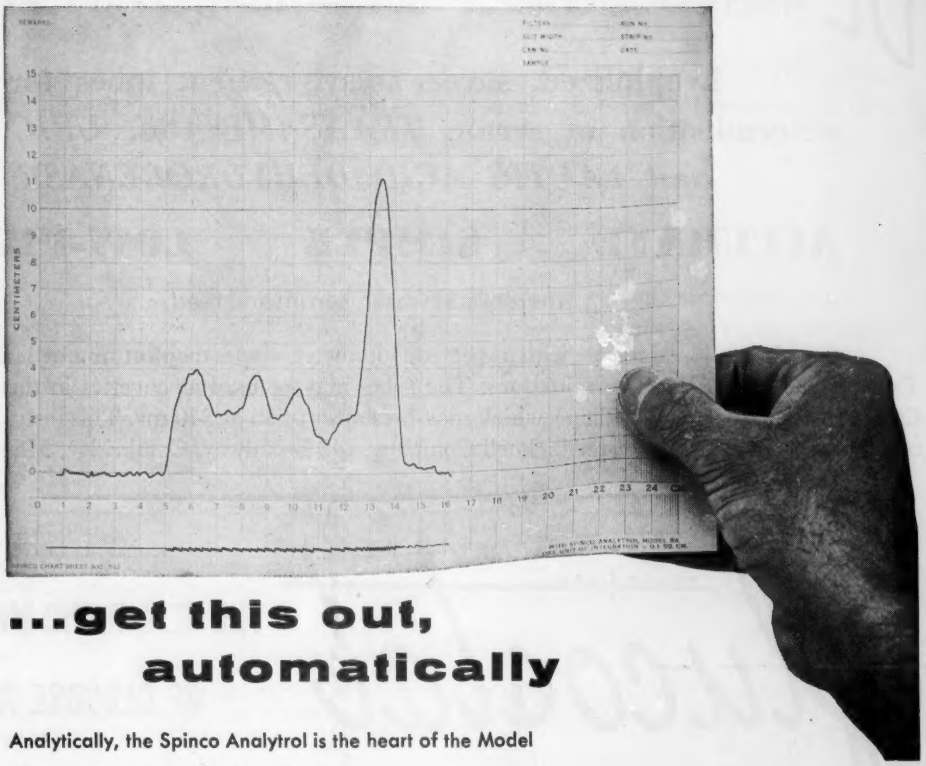

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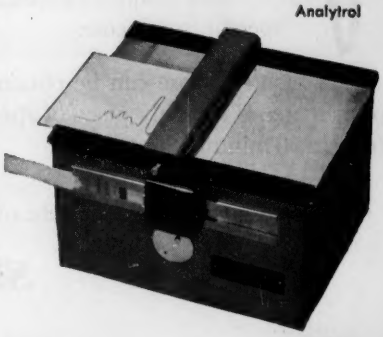

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